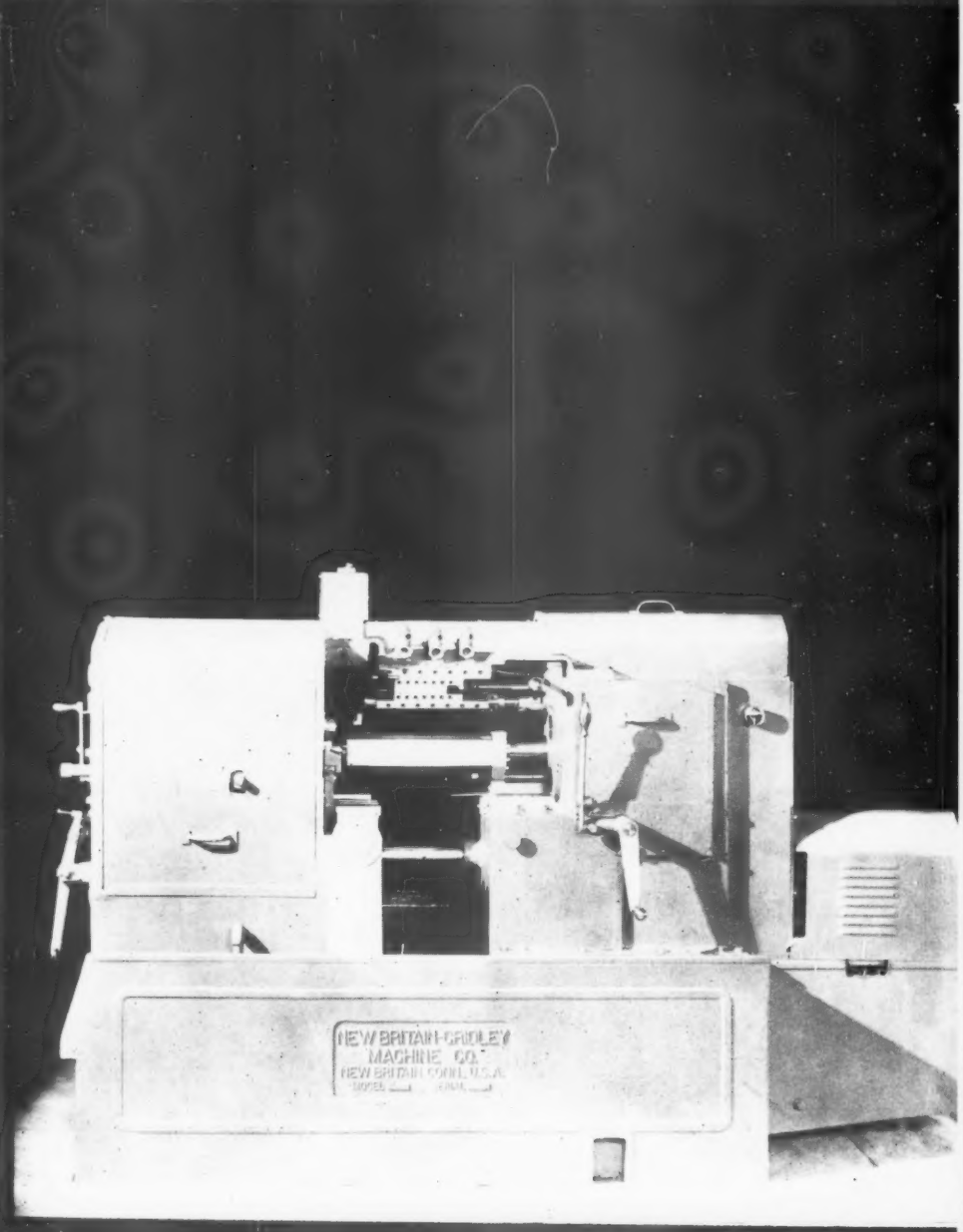
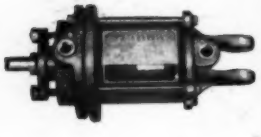
The Tool Engineer



Official Publication of the
AMERICAN SOCIETY OF TOOL ENGINEERS

POWER MOVEMENT IN ANY DIRECTION



SMOOTH, positive power applied direct to load or cylinder capacity may be multiplied by lever or toggle action.

Where an operator could devote the time now being spent in manually doing a job, apply a Hanna Cylinder and devote this time to productive labor contributing to an increase in production and lower costs.

Available in such a range of styles and sizes as to make installation for practically any requirements simple and inexpensive.

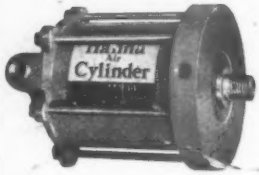
Cost of operation less than 1/1000 of a cent per foot of stroke per hundred pound force.

Hanna Cylinders may be mounted vertically, horizontally or in any other position and deliver the same powerful, smooth, positive thrust or pull motion.

Select an operation in your plant involving a pushing, pulling, lifting or lowering motion and compare cost of doing it with a Hanna Cylinder.

To learn price of cylinder specify following:

1. **Cylinder diameter or force required.**
2. **Length of stroke.**
3. **How cylinder is to be mounted.**



PUSH—PULL—LIFT—WITH HANNA CYLINDERS

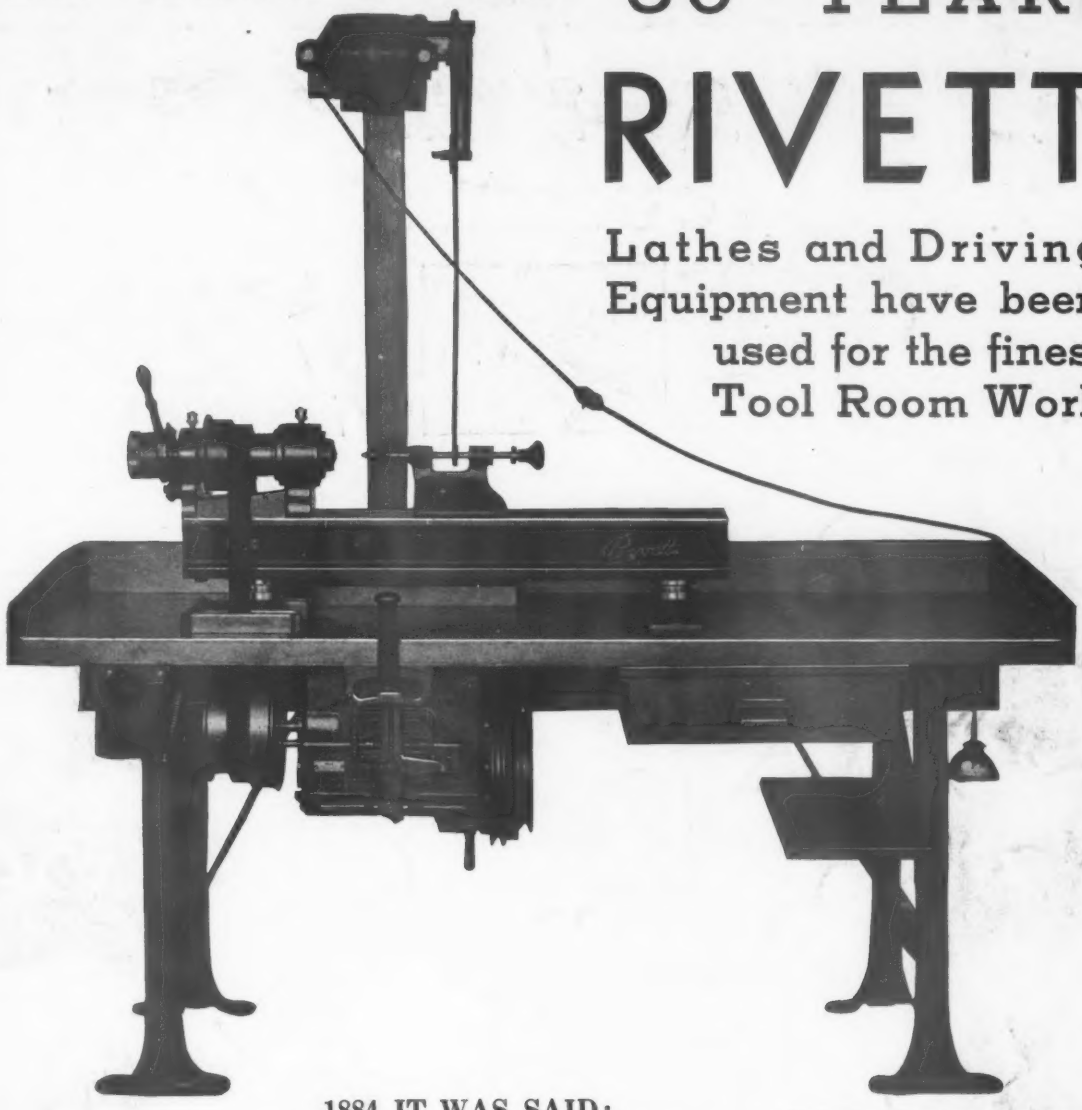
HANNA ENGINEERING WORKS

1765 ELSTON AVENUE **CHICAGO, ILLINOIS**

FOR MORE THAN 50 YEARS

RIVETT

Lathes and Driving Equipment have been used for the finest Tool Room Work



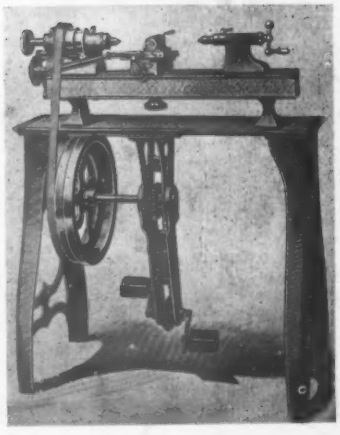
1884 IT WAS SAID:

"The Rivett lathe with bicycle foot power is of improved form and superior construction,—and is found pleasing to the operator."

1935 IT IS SAID:

"The years of experience and the constant development of Rivett bench lathes and drives have placed them foremost in the field."

Plain, roller and ball bearing lathes in several collet capacities are available. Rivett Speed Box Motor Drive with automatic brake provides 6, 12, or 18 speeds from 100 to 4600 R.P.M. forward and reverse through flat or Vee belts. Attachments requiring overhead drives may be driven from the unit motor on removable and adjustable upright. Write for descriptive material on Rivett lathes and drives.



See –
RIVETT BENCH LATHE EXHIBIT
BOOTH 1010
N.M.T.B.A SHOW

RIVETT LATHE & GRINDER INC.

BRIGHTON, BOSTON, MASS.
Pioneers in Bench Lathe Development

FOOTBURT

Our Booth No. 912 at The Machine Tool Show in Cleveland, September 10 to 21, will contain our latest developments in better machining methods. We would like to tell you about them and discuss the advantages of using modern Footburt equipment in solving your drilling, boring, reaming, tapping or surface broaching problems. Be sure to look us up.

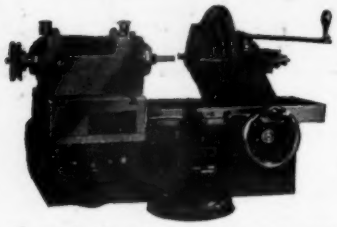
The Foote-Burt Company

Cleveland, Ohio

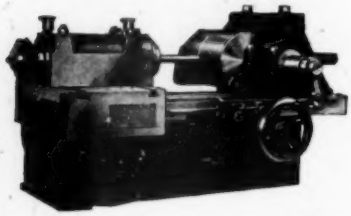
Detroit Office 4-151 General Motors Bldg. - - - - - - - Chicago Office 565 Washington Blvd.

Pioneers in Better Machining Methods

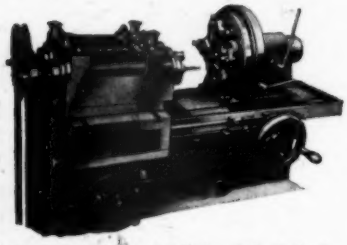
• SIMPLIFIED BORING •



A quick clamping and ejecting type of work holding fixture.



A universal piston fixture for larger sizes of pistons, quickly adjustable, rigid, accurate and quick clamping.



Two spindles parallel with indexing clamping fixture for boring small connecting rods at both ends.

Spindles arranged for double end operation with fixture in middle. (Boring gear pump bodies and covers).

Simplex Precision Boring Machines have simplified and reduced the cost of boring for a large variety of products — while maintaining a high degree of accuracy for size, roundness, straightness, and finish.

Advantages

(1) **Low first cost** compared to other larger and more complex machines.

(2) **Low operating cost**—one semi-skilled operator can run several machines—power consumption only ½ hp per spindle—work clamped and removed quickly.

(3) **Elimination of chatter and vibration** is secured by the construction of the spindle bearing. Spindles can be readjusted by users in their own shops.

(4) **Wide ranges of speed and feed** are provided, and work may be doubled up by operating two or more spindles end to end or parallel.

(5) **Most metals are readily bored** — cast iron, steel, and non-ferrous metals.

Send us prints or samples of your work and we will send our recommendations with complete descriptive bulletin and prices.

DOMESTIC REPRESENTATIVES

Pioneer Engineering & Mfg. Co., Detroit, Mich.
Geo. D. Miller Co., Cleveland, Ohio
Bradley Machinery Co., Chicago, Ill. Milwaukee, Wis. Rockford, Ill.
Colcord-Wright Machinery & Supply Co., St. Louis, Mo.
Harron, Rickard & McCone, San Francisco, Cal.
National Supply Co., Toledo, Ohio
Illinois National Supply Co., Indianapolis, Ind.
Russell, Holbrook & Henderson, Inc., New York, N. Y.
Smith, Booth, Usher Co., Las Angeles, Cal.
William K. Stamets, Pittsburgh, Pa.
Charles W. Stone, Minneapolis, Minn.
George Taylor, Boston, Mass.
Canadian Fairbanks, Morse Co. Ltd., Toronto, Windsor, Montreal, Quebec, Canada

Simplex Carbide Grinding and Lapping Machine. Built for dry grinding and lapping, or with complete equipment and guards for wet grinding.

STOKERUNIT CORP. 5325 WEST ROGERS STREET MILWAUKEE, WISCONSIN

MODERN MAGIC CHUCKS

No Slowing Down
No Stopping •

With MODERN MAGIC CHUCKS you make your tool changes while the machine is running at cutting speed. Changes from drill to reamer to tap instantly and safely made with one hand.

MODERN MAGIC CHUCKS give multiple spindle range to single spindle machines.

Drills, reamers, counterbores, taps and other tools are all accommodated and all operations for any one set-up can be performed without removing the work.

MODERN MAGIC CHUCKS are strong and sturdy. They are of simple construction . . . no complicated parts to wear or get out of order . . . fully guaranteed in service, material and workmanship.

Write for Bulletin M-100-A

MODERN TOOL WORKS

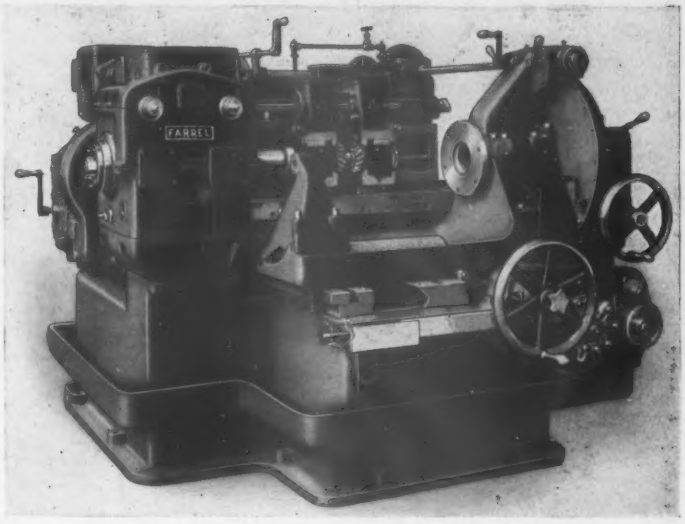
561 BLOSSOM ROAD **ROCHESTER, N. Y.**

Division of Consolidated Machine Tool Corporation

FARREL-SYKES GEAR GENERATORS

For the latest developments in gear generating see the Farrel-Birmingham exhibit at the Machine Tool Show.

BOOTH NO. 105-A



Size 2-B Farrel-Sykes Gear Generator. Capacity: 0 to 25" dia.; 0 to 8" face; 24 to 3 D.P.; maximum cutting strokes 700 per minute.

In the design of the latest type of Farrel-Sykes Gear Generators full utilization has been made of the technical progress of the last few years.

The improvements in design are noteworthy but most important is the improvement in performance. New features enhance accuracy of the product, increase output and facilitate operation.

The new Farrel-Sykes Gear Generators have extreme rapidity of action, yet they are remarkably quiet in operation. They are built with initial precision of the highest order, and maintenance of precision is insured by the use of hardened, ground and lapped surfaces where wear is likely to affect precision, and by the provision of means of compensating for wear.

A new automatic in-feed mechanism on the No. 1-A and 2-B machines makes them fully automatic except for setting up and changing the work. The latest type of cutter relief mechanism not only permits higher operating speed, thus increasing production, but also improves materially the accuracy and finish of the work and greatly lengthens the life of the cutters.

Farrel-Sykes Gear Generators are not limited to cutting continuous herringbone teeth but will generate any known type of herringbone gear, as well as straight tooth and single helical gears, external and internal, and a variety of toothed forms and special contours. Two members of a cluster gear, such as are used in automobile transmissions, can be cut simultaneously.

The Sykes machines are the most universal of gear generating machines and do a wider range of work with greater facility, speed, accuracy and economy than is possible by any other equipment at present available.

Don't fail to see these machines at the Machine Tool Show. Our engineers in attendance will be glad to explain details of design and to demonstrate the operation of the machine.

STERLING-FRENCH MACHINERY CO.

423 New Center Building, Detroit

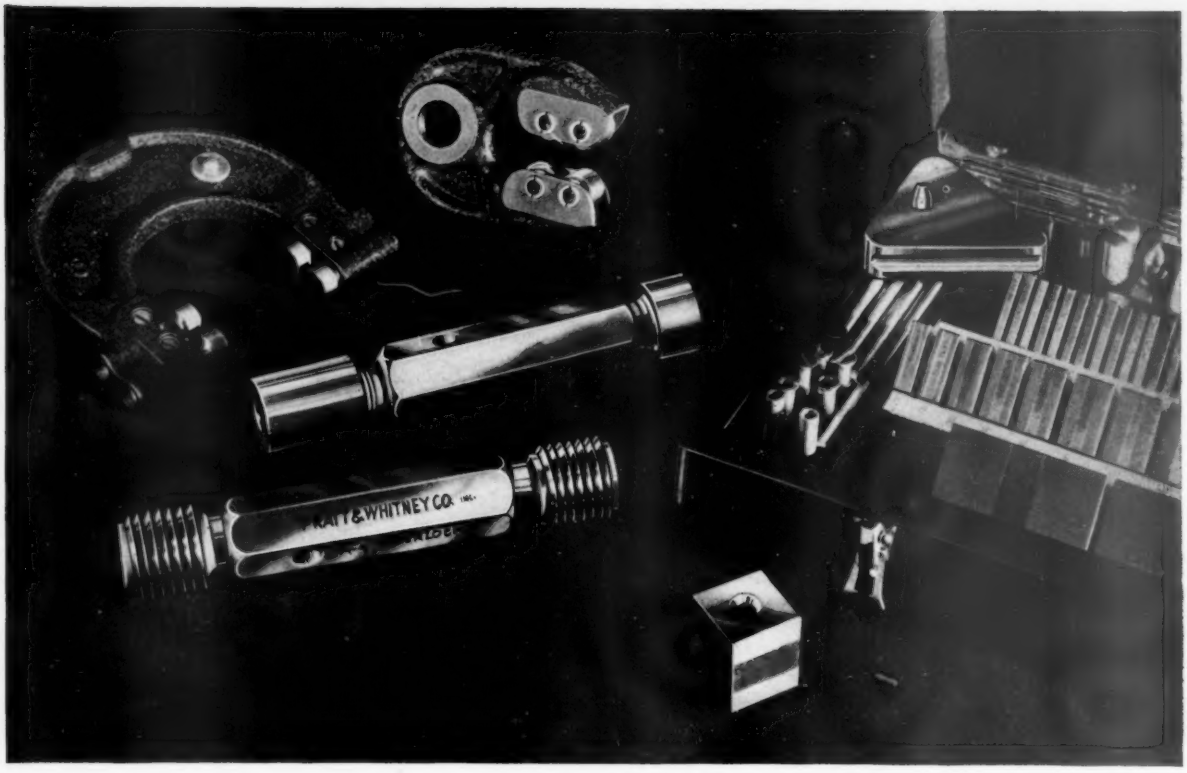
have been appointed exclusive sales representatives for the Farrel-Sykes Gear Generators in the Detroit area.

Their extensive experience in the machine tool field gives them exceptional qualifications to handle the Sykes machines and inquiries to them will receive their prompt and careful attention.

They will be at our booth at the Machine Tool Show in Cleveland and will welcome the opportunity to show you the Sykes machines in operation.

FARREL-BIRMINGHAM COMPANY, INC.

358 Vulcan Street, Buffalo, N. Y.



MANUFACTURING SECURITY LIES IN DEPENDABLE GAGES

The art of making gages is not alone in making them accurate. They must remain accurate through a long and useful life. It becomes a question of steel and metallurgy, plus precision workmanship.

You can be sure of gages made by Pratt & Whitney. They are the best that painstaking effort and seventy-five years of gage experience can make. Put them to work guiding your production. It is a comfortable feeling to know that accuracy—dependable accuracy—is at the wheel.

We produce a long list of standard and special gages for many industries. We have gage experts who will be glad to give you the benefit of their experience. They have data on gaging methods and tolerances that you will find valuable in your work.

When you buy gages use Pratt & Whitney gage making facilities and experience. They cost no more, and in the end usually cost less. In the meantime let us send you literature showing our standard gage products.

PRATT & WHITNEY CO.

HARTFORD, CONN.

The Tool Engineer

Trademark Registered in U.S. Pat. Off.

Official Publication of the AMERICAN SOCIETY OF TOOL ENGINEERS

Vol. IV. SEPTEMBER, 1935 No. 5

Application blanks and information pertaining to membership in the American Society of Tool Engineers may be had by addressing *The Tool Engineer*, 2842 W. Grand Boulevard, Detroit, Michigan, or the Secretary's office, 31 Melbourne Ave. Detroit, Michigan. **Dues** are $5 initiation fee, $3 per year for senior grade membership and $2 per year for junior grade membership.

The Tool Engineer is published on the first Thursday of each month. It is the official publication of the American Society of Tool Engineers, Incorporated. The membership of the Society and readers of this publication are practical manufacturing executives such as master mechanics, works managers, tool engineers, tool designers and others who are responsible for production in hundreds of plants throughout the nation and in foreign countries.

Owing to the nature of the American Society of Tool Engineers organization, it cannot, nor can the publishers be responsible for statements appearing in this publication either as papers presented at its meetings or the discussion of such papers printed herein.

Published by

THE BRAMSON PUBLISHING CO.

2842 W. Grand Boulevard Detroit, Michigan

Roy T. Bramson, *Publisher and Editor*

Advertising Offices

Cleveland, Ohio
216 Union Bldg.
Cherry 5473

Chicago, Illinois
Box 286
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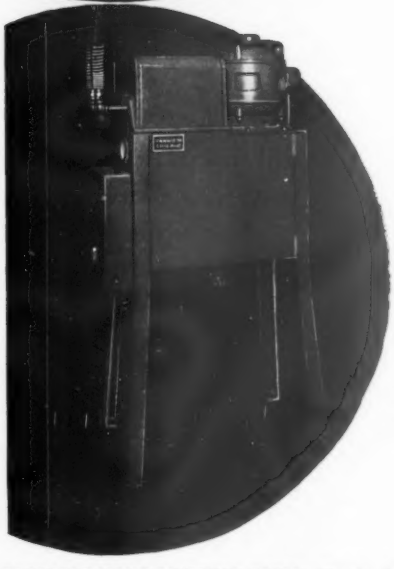
Principal Features, This Issue

RIVETING

as fast as ~~1-2-3~~ and much easier



THE "Hi-Power" Portable Hydraulic Riveter is an entirely new development for production riveting, comprising a portable yoke-type press weighing but 54 lbs., and a completely automatic hydraulic power unit driven by a 2 hp. motor and taking less than 4 square feet of floor space.

A single push button controls the entire operation of the press. Maximum pressure of 35,000 lbs. is ample for heading 3/8-inch cold rivets, and the complete cycle takes only *2½ seconds*.

This combination of large capacity, high speed, and easy handling means new economies and remarkable production in any riveting operation within the capacity range.

See this new Hannifin Portable Riveter at the Machine Tool Exposition. Other Hannifin special production units for modern high speed manufacturing, and the complete line of Hannifin air and hydraulic presses, air operated chucks, valves, and other production tool equipment will also be shown.

Hannifin Manufacturing Company
621-631 South Kolmar Avenue, Chicago, Illinois
ENGINEERS • DESIGNERS • MANUFACTURERS
Pneumatic and Hydraulic Production Tool Equipment
Detroit Office — Hayward Bldg., 4829 Woodward Ave.
Tel. COlumbus 4949 R. A. Bean, Mgr.

At the Machine Tool Exposition **Cleveland, September 11-21**

BOOTH 104

PORTABLE YOKE RIVETING PRESS—Weight 54 lbs. Throat of yoke 6 x 6 inches. With 4-inch reach, weight 45 lbs. Stroke 3 inches. Capacity 5/8-inch cold rivet.

HYDRAULIC PRESSURE GENERATOR—Completely automatic valve and oil pump control. Working pressure 5,000 lbs./sq. in. Motor 2 hp. Dimensions 32 x 17 x 56 inches. Large volume delivery at moderate pressure for rapid advance and return strokes.

OPERATION—Complete automatic riveting cycle controlled by a single push button. Cycle includes rapid advance at moderate pressure, automatic high pressure delivered when die touches rivet, and reversal at peak pressure with rapid return to starting position.

At end of return stroke controls automatically move to neutral and oil pump idles at zero pressure.

SAFETY—No repeat—the control button must be released and pressed again for another cycle.

Instant safety stop—releasing the control button at any point in the cycle automatically reverses the ram and returns it to starting position.

HANNIFIN

"hi-power"

PORTABLE HYDRAULIC RIVETER

AMERICAN SOCIETY OF TOOL ENGINEERS SESSION

MACHINE TOOL CONGRESS

CLEVELAND, OHIO---SEPTEMBER 13th, 1935

STATLER HOTEL

BANQUET 6:30 P.M.

TECHNICAL MEETING 8:00 P.M.

* This supplants the regular September Meeting of A.S.T.E. in Detroit

☆ BANQUET---6:30 p. m.---Good Food---Entertainment---Music ☆

The banquet of the American Society of Tool Engineers preceding this important technical session of the Machine Tool Congress is one of the highlights of this extraordinary industrial event. Special and most unusual entertainment has been arranged for. By all means *don't* miss this. $1.50 per person to non-members and guests. Included in special base price accommodations on A.S.T.E. trip from Detroit.

☆ TECHNICAL SESSION---8:00 p. m.---Two Speakers ☆

The carefully formulated plans for this occasion have taken several months of painstaking efforts on the part of the officers of A.S.T.E. and many committee members. In connection with this very important meeting the work of the "On-To-Cleveland" Committee, of which Mr. Ford R. Lamb, First Vice-President is Chairman, and the A.S.T.E. Standards Committee, of which Mr. W. H. Smila is Chairman, has been of unmistakable value. As President of The Society Mr. Lippard will preside at this meeting. He, no doubt, will have a message for all Tool Engineers and the practical mass manufacturing executives who attend this session of the Congress.

ROBERT M. LIPPARD
President, American Society of Tool Engineers Presiding

WILLIAM H. SMILA
Master Mechanic of Chrysler-Jefferson Plant, Detroit, Michigan

SPEAKER: William H. Smila

Master Mechanic of Chrysler-Jefferson Plant, Detroit, Michigan

SUBJECT: "Standardization of Machine and Tool Data

This address describes the inauguration and purpose of the A.S.T.E. Data Sheets.

While the speaker is to touch on the various ramifications and aspects of standardization as related to the supplier of equipment, his viewpoint is that of a user. Mr. Smila has literally "done everything".

After completing his college work at Ohio Northern, he started his career as an apprentice tool maker in 1911, and has gone all the way "through the mill" to his present position, where he represents one of the world's largest users of tools and machinery.

He was one of the original organizers of the A.S.T.E., is a charter member, has been on the Board of Directors since the inception of the society, was Vice-President of the A.S.T.E. in 1932, President in 1933, and now as Chairman of the Standards Committee, directs the work which he will describe.

ALEXANDER H. d'ARCAMBAL
Pratt & Whitney Company, Hartford, Connecticut

SPEAKER: Alexander H. d'Arcambal

Pratt & Whitney Company, Hartford, Connecticut

SUBJECT: "Trend of the Development of Cutting Tools"

Alexander H. d'Arcambal was born in Kalamazoo, Michigan, January 23, 1890. He attended Detroit Central High School and was graduated from the University of Michigan with the degree B. of Ch. E. in 1912.

Mr. d'Arcambal has been very active in promoting the profession in which he is so interested, through his many activities with the American Society for Metals. He has served as Chairman of the Hartford Branch of this Society, has served on the Directorate and has been Vice-President and President of this important body. He has addressed every branch of this Society during the past ten years and has also served on several committees of the national headquarters.

The nature of the subjects and the wide experience of speakers, and the fact that this meeting is to be held in conjunction with our trip to the National Machine Tool Show in Cleveland, makes this without exaggeration one of the most important meetings ever sponsored by The Society.

A MESSAGE from the PRESIDENT

AS we look forward to the activities of our Society for the coming months I am sure we are all anxious for a resumption of the interesting and educational dinner meetings which have been held in the past.

We are particularly fortunate this year in having the opportunity of holding our first meeting at Cleveland in connection with the Machine Tool Congress which will be in session during the Machine Tool Show. At this meeting we are again to have the privilege of hearing our good friend Mr. A. H. d'Arcambal speak, his subject being, "Trend of the Development of Cutting Tools." Those of you who heard him at our meeting last April will be glad of the opportunity of hearing him again.

Our Standards Committee Chairman, Mr. W. H. Smila, will also speak, his subject being a report on the activities of the Standards Committee and the introduction of the new standard tool engineering data sheet. This report will be of particular interest to our members as well as to the entire machine and small tool industry, and I am sure that the work that this committee has been carrying forward will be a revelation to everyone and a real credit to the Society.

Every member who can possibly attend should be there, and from the plans which the Cleveland Trip Committee have laid out I am sure a good time is in store for all.

In connection with this trip to Cleveland, I had the pleasure of talking with one of the officials of the Machine Tool Show and was amazed at the magnitude of the Show and the new developments which have been made during the period of the depression. Many machine tool manufacturers will show equipment and methods which are entirely new to the majority of users and it goes to show that even though we have been through a most difficult period, at the same time hope for a brighter future has been ever present in the mind of this enterprising industry.

It has frequently been said that the day of the pioneer is past; that the age of discovery passed out with the nineteenth century and that the spirit of adventure which was ever present in the earlier days has been lost. It is probably true in one sense of the word that new lands are few and that the pioneer in a literal sense has very little opportunity to develop new areas as in the days of the Fortyniners. However, today we are finding amongst us a new group of pioneers, men who have had the courage and farsightedness to develop the automobile, the radio, the electric refrigerator and many other benefits to mankind, which have gone a long way in raising our standard of living and in aiding us in our pursuit of happiness.

As we look into the development of these various products we are amazed by the part played by the tool engineer. We find that only through the development of machine tools, the "Master Tools of Industry," and small tools, jigs, gages and fixtures used in connection with them, has it been possible to make the strides that have been made.

The tool engineer should feel proud of the part which he has played and the part which he is constantly playing in the development of ways and means which make it economically possible to produce these various new products at a cost that will permit wide distribution so that all may enjoy the benefits of their use.

The American Society of Tool Engineers hope that they may further the good work which is being done by doing all that is possible to further the art and science of tool engineering among the members of the Society and the industry at large, and to bring about a spirit of goodfellowship and brotherhood amongst those engaged in this profession.

First, we must have an ideal. Then the will to do. We already have these and now all that is required is the continued effort on our part to push forward to aid the modern pioneers to succeed in their fields of development.

I hope to see you all in Cleveland!

R. M. LIPPARD
President
American Society of Tool Engineers

PRODUCTION PERSPECTIVES

W. P. KIRK

Chairman
Exposition Committee
National Machine Tool
Builders' Association

IN THE midst of a very busy period (the busiest in some five years or more), Tool Engineers and production executives everywhere will go to the biggest industrial event of its kind in history—the Machine Tool Show. **All roads lead to Cleveland September 11th to 21st.** Special **low transportation rates** from all parts of the country will be extended to visitors to the Machine Tool Congress, held in Cleveland coincident with the Show. More than twenty-five thousand visitors to the Show and Congress are expected. September 13th will be A.S.T.E. Day for members and their friends, particularly those who make the trip from Detroit via the large steamer *Greater Detroit* on an all-expense trip for as little as $10.00. More than 1,000 will make this trip, judging from reservations that are coming into the A.S.T.E. Secretary's Office. Many important executives, bankers, legislators, writers and others will attend a pre-view of the Exposition September 10th, and **September 20th** has been designated as a special **"Railroad Day."** On this day it is expected that the Railroad industry will be shown how operating costs can be lowered through the use of modern machine tools, for it is recognized that this industry constitutes a very substantial potential market. The size and scope of this tremendous exposition could hardly be given adequate description in all of the pages of this publication, but elsewhere will be found some of the more salient features you will not want to miss when in Cleveland. Exhibits of the various manufacturers are extraordinary in their unusual appeal and presentation and the novel methods of demonstration. One exhibitor, celebrating his 50th Business Anniversary will have a **booth done in gold.** Other exhibitors have resorted to the use of very large photographs showing their machines and products in actual use. An interesting trend will be manifest in machine design toward modernistic lines and contours.

From Cleveland we hear that **R. B. Nuckols,** formerly with his company's St. Louis office, has been named assistant sales manager of the **Standard Tool Company, W. P. Ross** continues as the general sales manager.

The White Motor Company closed down on August 3rd to celebrate their annual picnic at Geauga Lake Park.

H. T. Canavan of the **Norton Company** won the Medusa Cement trophy in the golf tournament of the Cleveland Association of Credit Men on July 18th.

Neely Powers of the **Universal Steel Company,** Cleveland, has been named president and general manager of the recently re-incorporated **Colson Corporation of Elyria,** Ohio.

The Rotor Air Tool Company is putting out a new light-weight model drill made in both reversible and non-reversible types in two speeds of 450 R.P.M. and 360 R.P.M.

The Baker-Raulang Company has a new and improved **"Hylift"** industrial truck of 5 ton capacity.

The Associated Machine Tool Dealers will hold their annual meeting at Hotel Cleveland on September 9th just preceding the Machine Tool Show.

J. W. Corey, sales manager, and **S. B. Taylor,** works manager, of the **Reliance Electric & Engineering Company,** have been elected to the board of directors of this company.

The air conditioning department of the **Westinghouse** Electric & Mfg. Company has been **moved** from **East Pittsburgh,** Pennsylvania, to **Mansfield, Ohio,** where it will become a part of the merchandising division. The company's plant at East Springfield, Massachusetts, will continue as the big point of manufacture.

H. H. LIND

General Manager
National Machine Tool
Builders' Association

From the Hoosier State, we hear, several **comprehensive plant extensions** are **under way.** At Fort Wayne, **International Harvester Company** is spending **$1,000,000 on an expansion program.** A one story building **to house a machine shop** and a repair department will soon be under way. The plant at present employs 4,000 men. **The Delco-Remy Corporation** and the **Guide Lamp Corporation,** two units of **General Motors,** will close their plants the latter part of Au-

gust for inventory. Previous reports from these plants **indicate much better conditions** when the plants **reopen in September.** The Delco-Remy Corporation is **employing several hundred more men now** than they were at this time last year.

Following reorganization, **The American Dirigold Corporation,** successor of the Dirigold Company, has moved into the **old Haynes automobile plant** and has begun production of tableware and trophies. John P. Frederick is president and treasurer of the corporation; Glen R. Hillis, vice-president, and Robert Arnett, secretary. Carl Moline and Virgil L. Coffel are other directors.

The American Dirigold Corporation recently **registered the trade-mark, "Dirigold"**—Class 13, **hardware and plumbing,** and **steam fitting supplies**; 14, metals, and **metal castings and forgings,** and Class 22, cutlery, **machinery and tools** and parts thereof.

Albany Manufacturing Company, Inc., Albany, Ind., organized to **manufacture machinery,** has appointed H. E. Humphreys, 1410 North Walnut Street, Muncie, as resident agent. **Allison Engineering Company** at Speedway, just west of Indianapolis, **division of General Motors Corporation,** has **announced** an **extensive expansion program** including the **construction** and equipment **of four modern buildings** with a total of 41,000 square feet of floor space, work on which is to start immediately. The plant **improvements include facilities for the production of a new 1,000-horse power** liquid-cooled **aircraft engine,** which will be one of the most powerful aviation power plants made in this country. The engine has been under development several years. The new facilities will be ready for use in four months. The manufacturing unit, 122 by 251 feet, providing 31,000 feet of floor space, will be constructed of brick and steel. This unit **will house the machine shop, electric furnace room,** paint shop and shop offices. Equipment also will be of the most modern type, including monorail hoists and a traveling crane, each individually electrically operated. General Motors acquired this plant in 1929.

CHAS. J. STILWELL

President
National Machine Tool Builders' Association

In the Detroit area Tool Engineers generally have been very busy the past thirty days, much new equipment has already been purchased and **tooling programs have progressed considerably** during this period.

Charlie Jinnette, for twenty-five years Norton Company Detroit branch manager, has been **made Regional Manager of Sales Planning and Development for the Middle West,** by the Norton Company, Worcester, Massachusetts. **P. H. Clapp** who succeeds Mr. Jinnette, as Detroit branch manager for the company, comes from the Pacific Coast.

We see that Scandinavians of the Detroit area recently had an outing in which **Mr. W. S. Knudsen,** Vice President of General Motors Corporation gave an address. An interesting sidelight of the occasion was the large number of A.S.T.Eers and their friends who were present, some of these were **Carl W. Oxford, Ture Franzen, George Ringstad, Otto Schjotz,** and Messrs. **Lindstrom and Berg.** More than 2000 people attended the affair.

Lou Beach, A.S.T.Eer of Packard Motor and W. F. Babcock, surely are fishermen from what we hear, and know how to "bring them back."

Larry Kruse, A.S.T.Eer has fully recovered from a serious illness and is again back on his job.

Hayward Gay, A.S.T.Eer of the Cincinnati Milling Machine and Cincinnati Grinders, Inc., is **now on a honeymoon.** A number of A.S.T.Eers and friends of Mr. Gay attended a party in honor of the newlyweds at the home of Mr. **Swan Bergstrom.**

Our good friend **Professor Orlan W. Boston,** Director of the Department of Metal Processing at the University of Michigan, Ann Arbor, has recently published several engineering publications which are of considerable interest to Tool Engineers, one new volume is a continuation of **"A Bibliography on the Cutting of Metals."** This bibliography covers the past five years of experimentation and results and contains 1257 new references carefully abstracted, arranged chronologically by author and indexed by author and subject. The price is $2.50. **"Engineering Shop Practice"** volume II, just off the press is an accurate treatise giving specific information on the important methods, processes, machinery and tools used in machine shop work, 539 pages, price $5.50.

J. F. GEPFERT

President
The Cleveland Engineering Society

EDITORIAL

WHO IS A TOOL ENGINEER?

BY O. B. JONES
CO-FOUNDER A.S.T.E.

The general public would derive little benefit from knowing what a Tool Engineer is, since his duties are best discharged without actual contact with the public, though his services to the public are greater than those of many so-called public servants. There are, however, thousands of men in the general profession of engineering who can and will benefit by such a knowledge.

At first thought it would seem obvious that every Tool Engineer knows what constitutes a Tool Engineer. But when it is recalled that the term was first applied to a certain field of engineering activity only about ten years ago and has come into its present fairly general use within the past three years it is conceivable that such might not be the case. Persons engaged in a nameless kind of engineering thousands of miles from Detroit, birthplace of the name "Tool Engineer," might not know that at last their peculiar profession has been given the dignity of a name and that a national organization has started its roots in the Capital of Transportation and is offering them the advantages accruing to its members.

Persons who design the machines used in production or evolve the methods or processes of manufacturing are Tool Engineers. Persons performing these functions in plants throughout the country are often called Master Mechanics, Chief Draftsmen, Tool Supervisors, Chief Tool Designers, Tool Superintendents, and so on. The difference in their titles has had a tendency to obscure the fact that they are performing kindred duties.

The American Society of Tool Engineers provides a clearing house for new ideas pertaining to manufacturing, a common meeting place, a forum, an opportunity, for concerted action for all men engaged in planning or supervising the tooling of a manufacturing plant. It provides grades of membership suitable for all gradations of ability from the collegiate engineering student and the tool detail draftsman to the plant superintendent.

Mass production of the means of transporting tangible objects and thoughts, and the mass manufacture of innumerable other labor-saving and pleasure-giving devices constitute the only foundation upon which our present high standard of living could have been attained. The creation of our present manufacturing processes accounts for nearly all our recent educational and cultural advancement.

Starting a half-century ago a peculiar type of mechanical genius began pulling itself away from traditional and legendary engineering and began to develop ideas of interchangeable manufacture. Their ideals are far from being attained. Tremendous strides will be made by them in the coming decade making us ashamed of our 1935 crude manufacturing methods. The leaders in this group are the Master Mechanics, Chief Draftsmen, Tool Supervisors, Chief Tool Designers, Tool Superintendents and General Superintendents, as referred to above.

They have been laboring without the benefit of any means of close cooperation such as the American Society of Tool Engineers is now providing, and will continue to provide in a much more comprehensive manner when the thousands who are now laboring in isolation learn of the organization of this Society and affiliate themselves with it.

The directors of the Society, in determining the qualifications for membership, have given more consideration to the applicants record of practical experience than to his college rating. In fact, he need not be a graduate of any college. For senior membership his record of employment must indicate a thorough knowledge of manufacturing methods. He must have the ability to originate practical production plans. He must be able to plan the proper sequence of operations to completely produce a detail. He must be able to design the necessary machine attachments (tools) or a machine.

It is not the thought of the directors that a college degree in engineering is, "a bootleg label on an empty bottle." It is their conviction, however, that while the general analytical ability developed by the college course in engineering is a decided asset to a tool engineer, the college training in itself is not sufficient to enable one to do tool engineering. Many of the best tool engineers in America today have not had the benefit of college training in engineering. Certainly their accomplishments would have been even more gratifying had they been so trained.

Realizing the major role the tooling of a plant plays in the entire manufacturing project and realizing the necessity for assembling and organizing fundamental practical technical knowledge from all fields of engineering and manufacturing, in order that the tooling might be developed in accordance with the latest known facts, a group of leaders in modern plant tooling in Detroit developed the nucleus of a national society for tool engineers.

We do not wish to detract an iota from the essential part played by capital in manufacturing; or to withhold from its managers the praise due them for their display of genius in its management; nor to infringe upon the world of glory in which product engineers bask. We do wish to emphasize and amplify what we hinted at in the beginning, namely— the Tool Engineer, regardless of the title under which he has labored in the past, is the one who has done the actual tool or production engineering which because of its effect upon our everyday mode of living, causes the average citizen to have faith that if he has the "down payment" any luxury of which he might dream can be his.

Though the Society is nicely started and is getting the finest kind of cooperation from all quarters,

(Continued on page 65)

CLEVELAND READY FOR LARGEST MACHINE TOOL SHOW EVER HELD . . . .

By WILSON B. FISKE
CLEVELAND CORRESPONDENT
The Tool Engineer

EVERY foot of space in Cleveland's mammoth Public Auditorium and Industrial Exhibition Hall will be taken when the National Machine Tool Show opens on Sept. 11 for the greatest ten day spectacle of man-made tools ever witnessed. Reservations have been coming in for months and a total of 238 exhibitors were assured by August 1st. In fact, many demands for space have had to be turned down because the 5.3 acres of showing space was required for machine tools and related machine shop products. Close lines of restriction had to be drawn as large numbers of unrelated manufacturers and jobbers tried to secure booths.

The big show and the Third Machine Tool Congress, which is being held concurrently, have flooded the city with hotel reservations. It is now virtually assured that the earlier estimate of 25,000 visitors and attendants will be reached. Members of the National Machine Tool Builders' Association, the American Society of Mechanical Engineers, the Society of Automotive Engineers, the American Society of Tool Engineers and the Cleveland Engineering Society who are directing the great meeting, advise that they have never seen such enthusiasm before. Exery state in the union will be well represented as well as every province in Canada and a large number of foreign countries. France and England reservations started coming in early. A formal dinner will be held on Tuesday evening, Sept. 17, in special honor of the overseas delegation.

September 13 is A.S.T.E. Day at the Show. More than 1,000 A.S.T.E. members and their friends in industry will leave Detroit Thursday evening, September 12 via the *S.S. Greater-Detroit*, world's largest inland steamer. A very nominal charge of $10 for an all-expense trip has been arranged by The Society which will include transportation, berth accommodations, breakfast on the boat, entrance to the show, souvenirs, and the banquet at the A.S.T.E. technical session of the Machine Tool Congress to be held at the Statler Hotel in Cleveland and fully described on page 13 of this issue.

In view of the fact that great strides have been made in machine tool design since the last National Machine Tool show six years ago, the big 1935 display takes on added significance. During this period, machinery has been redesigned to present smoother lines and greater efficiency in operation. At the same time many totally new inventions to cut costs and speed production have been devised and placed

Cleveland Public Auditorium. This huge building with the Industrial Exhibit Hall will house the most spectacular and the largest assemblage of machinery and tools ever known. Nearly a thousand machines will be demonstrated under actual working conditions, thus presenting an enormous machine shop—educational, entertaining and of vital interest to the Tool Engineer and other practical mass manufacturing executives.

in use. From the standpoint of design, probably no other six year era has resulted in such progress. Today even beauty in machine tools is widely considered and the rugged, protruding gadgets of yesterday have been greatly simplified.

Over 2500 tons of machinery will be set up in the 1935 show. This will include a gigantic machine shop with 900 machines in full operation, representing an investment of $3,000,000. These machines will include everything from the smallest watch part producing instrument to the largest machines which fashion battleship parts. Ample electric current will be offered to pull the heavy load.

In the complete exhibition, there will be 238 booths ranging in size from 200 square feet to 4000 square feet. The installations will start on September 2, nine days before the great spectacle opens.

Visitors to the show will be made up mostly of executives and engineers but there will be a host of officials from utilities, banks, railroads, national and state governments, and other institutions who realize the vast part played by machinery in our daily welfare. Even Asia and Africa will be represented in the crowd of visitors. Technical experts will be in charge of each exhibit to explain their products.

The Cleveland Engineering Society has also sent out an invitation to all local chapters asking them to make use of the Cleveland offices and facilities while in the city. They will honor W. S. Knudsen, vice president of General Motors with a special dinner on the night he speaks before their group.

Exposition hours will be from 9 A.M. to 6 P.M. daily with the exception of Sunday, September 15, when it will be temporarily closed. Restaurant, post

office, telephone and telegraph facilities will be afforded.

In this age of sharp competition, the high cost of obsolete equipment will be fully demonstrated and the alert executive may find many improved ways of boosting his output at lower cost. Modern plant machinery also means better products which may increase the potential market of the manufacturer. Thousands of key executives will be on hand for the inspection. A knowledge of industrial advances during the past few years will re-act to the advantage of all concerned. The mechanical executive may here check the performance of the latest machinery against the present equipment of his own plant.

Machines that make machines will be featured in the Tool Show array, as well as the machine tools which are concerned with direct production. Everything from lathes to welding machines will be offered in this group.

One of the important controversies which the show is expected to settle, is that surrounding the so-called "Machine Age" and the part it is has played in employment. The National Industrial Conference Board is conducting a survey of mechanization in industry and a report to the National Machine Tool Builders' Association indicates that the creation of new modern tools has increased rather than decreased employment. At the same time it has alleviated the burdens of humanity while providing greater ease and comfort in living. During the Machine Age wages have been increased and, conversely, modern machinery has brought the cost of living necessities within easier reach of all. Despite the big increase in the output per man and a relatively small reduction in hours, the percentage of unemployment was smaller during the post-war period from 1923 to 1929 than in 1899 or 1904.

The National Industrial Conference Board reports that eighteen new industries not existing in 1879, absorbed almost one-seventh of all the labor employed in manufacturing activity in 1929. These eighteen industries were created by the advance in science, invention and technology. Of the eighteen industries, the automobile industry occupies first place in the employment of labor. In 1929 this industry employed about 450,000 workers, one-half of whom were engaged in the manufacture of vehicles and the other half in producing motorcycles, automobile bodies and parts. The electrical machinery industry occupies second place with an employment of 328,000 in 1929. The report goes on to show that total manufacturing operations in 1879 employed about 49,000 wage-earners for every one million inhabitants in the United States. In 1929, after a half century of progress, almost 73,000 wage earners were employed per million population. This represents an increase of 24,000 persons working per million population or an increase of close to 50 per cent. No less than two-fifths of this increase has been brought about by new industries. All of this is concerned with manufacturing operations alone and it does not take into account the still further large numbers employed in the transportation and distribution of these increased products.

During the period of 1920 to 1930 machinery has transformed the nation from an agriculture country to a land of diversified economic interests and high standards of living. A great panoramic view of the machine tools which have put automobiles, radios, refrigerators and washing machines in American homes will be afforded at the Third Machine Tool Show in Cleveland.

When Charles J. Stilwell, vice president of the Warner & Swasey Co., Cleveland, president of the National Machine Tool Builders' Associataion, calls the 1935 Machine Tool Congress to order, the leaders of industry and progress will convene to consider the further development of civilization. Technical sessions will be held throughout the Congress, affording a neutral forum wherein engineers, users, distributors and producers may discuss freely all questions of mutual interest concerning the design and utilization of machine tools.

Reduced railroad fares have been provided from every state and province in the country. Others may come by water and air.

Cleveland is centrally located for the 1935 meeting. A special Hotel Bureau, representing all hotels, has been set up to assure the great deluge of visitors the best in housing accommodations. Visitors will find here numerous points of interest as well as a convention city of great charm. Between Congress sessions and the inspection of exhibits, unlimited forms of recreation may be provided. Over a dozen fine golf courses are within easy reach while parks, bathing beaches and the American League ball park may appeal to many. Fine theatres, restaurants and stores will aid the delegates in passing a pleasant as well as lucrative stay here.

Cleveland industrial plants will be open to large throngs of interested visitors who may take inspection tours. The fact that Cleveland is the center of the automobile parts business makes it an especially fitting meeting place.

American Society of Tool Engineers

and its official publication

The Tool Engineer

Cordially Invite All Industrial Engineers and Executives

to visit

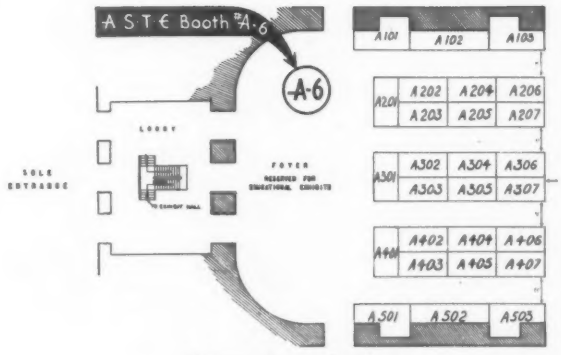
Booth Number A-6, in the Arena Foyer

at the

Machine Tool Show

CLEVELAND, OHIO

September 11th to 21st, 1935

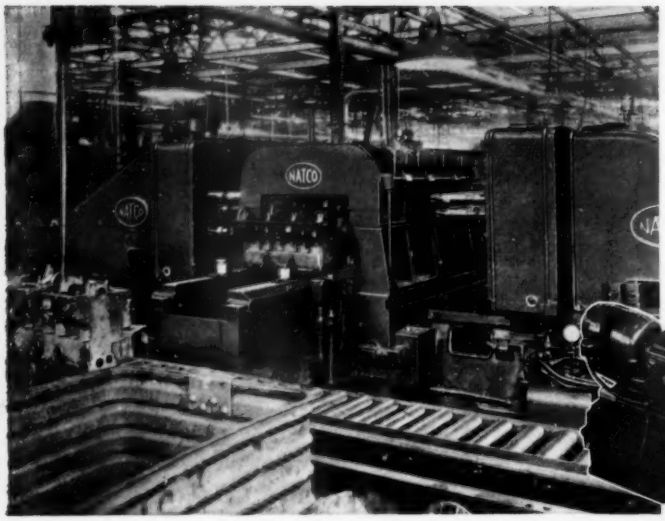


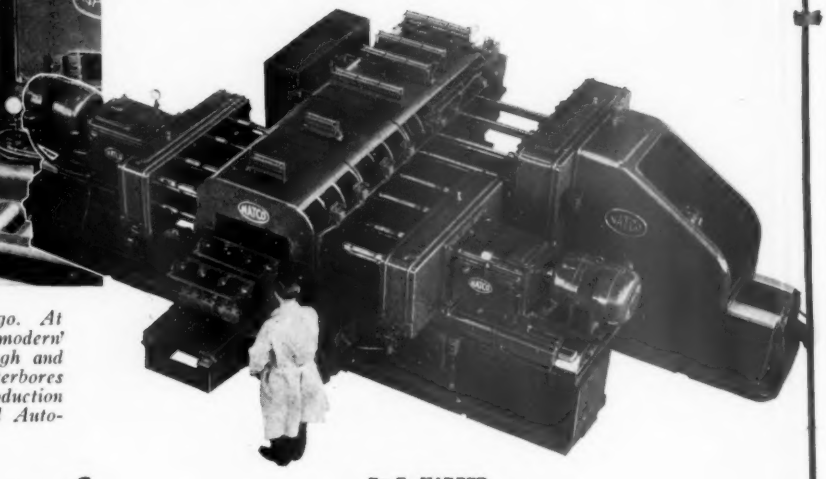
Foyer—Arena Section

Your visit to this educational exhibit will be an interesting and instructive insight into the purposes and activities of the American Society of Tool Engineers.

While in attendance at The Show and Congress you are invited to make this booth your headquarters.

Meet your friends and leaders of industry in this convenient and accessible location—just inside sole entrance to The Show.





Above is shown a boring machine of some years ago. At right is pictured a duplicate machine, but has the modern self-contained hydraulic units. These machines rough and finish cam and crank bores; and core drills and counterbores the welsh plug hole in cast iron cylinder block. Production 90 blocks per hour. Illustrations courtesy National Automatic Tool Co.

OLD and NEW METHODS of DRILLING

By E. HARPER
MEMBER A.S.T.E.
in collaboration with R. M. GALLOWAY

WE usually think of drilling in terms of our present day practice as used in high production jobs. It is interesting, however, to know that drilling in the broad sense, that is making a hole in some material, is probably among the oldest of the arts.

It is quite easy to realize that some one of our observant prehistoric ancestors noticed that when he twisted a stick or a bone against a piece of wood that he wore a hole into the wood. It is also quite conceivable that he found if he placed some dirt or sand at the point where the stick contacted the wood, the wear was increased. Archeologists have found articles which have apparently been used in this way for piercing holes. They have also found ornaments which have had holes pierced in them apparently by this method. We believe that this was the original method of drilling; that is by twisting a spindle of some kind against the material to be pierced, probably using grit of some kind to aid in the operation.

Many thousands of years later, some inventive genius discovered that by fastening a small piece of metal in the end of the spindle, the cutting efficiency was increased. These first drills were rotated forward and reverse between the palms of the hand. The process was extremely slow, but in those days time was no object.

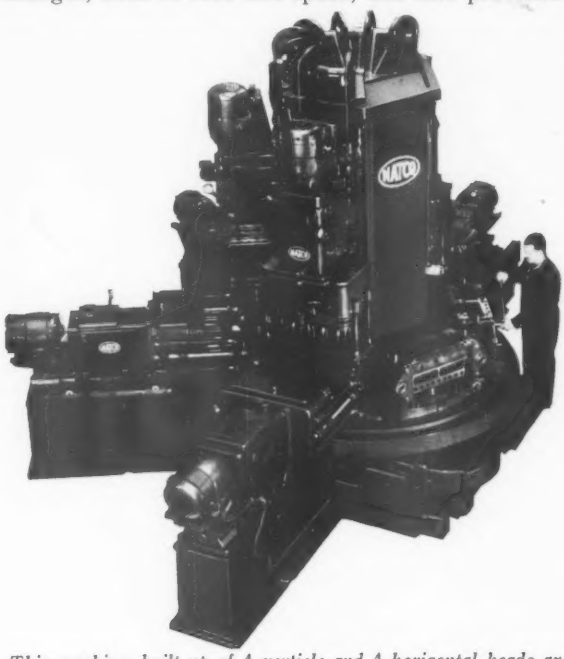
Still later, possibly after the invention of the bow as a weapon, it was discovered that by using a curved stick with a thong fastened at either end in the form of a loose bow string, and by taking one turn around the drill spindle with this thong, the spindle could be more rapidly rotated forward and reverse by a sawing action of the bow. This proved a means of applying a rotating movement to the drill much more efficiently than by spinning the drill between the palms of the hand. This method of rotating the drill was used for thousands of years, and is still used by oriental workers in ivory, metal and pearl shell. Many beautiful ornaments are still made by these patient, skilled artisans in the Orient by piercing the material with this crude form of drilling equipment. It is also of interest to know that the same form of drill in a somewhat improved shape has been used extensively in this country and Europe by jewelers and watch makers, and, in fact, is still used by some watch and jewelry repair men. It is a far cry from this crude method of producing holes to our present methods.

After the use of steel for tools became commonly practiced an early form of drilling machine was developed which was operated by hand power. Some of the later examples of this machine can still be seen in use in country blacksmith shops in districts where the automobile has not entirely superseded the horse. The machine was usually called a "Blacksmith's Drill," and consisted of a bracket or support which was bolted to a bench or to a wall post. The drill was rotated by means of a hand wheel and simple gear train; the drill being thrust into the work by a hand lever which applied the pressure to a drill surrounding the drill spindle.

A later development improved this hand lever feeding by utilizing a ratchet arrangement which

intermittently advanced the drill spindle from power derived from the hand wheel. A still further development in this type of machine provided for more than one speed and more than one rate of feed. The machine was, however, still hand operated. The cutting tools or drills used in connection with these early machines were usually forged by the blacksmiths themselves from round or flat stock, the end of the stock being flattened out and hand ground to a cutting edge.

After water power, and later steam power, came into use, modifications of these early hand operated machines were built, in which the power was provided by means of pulleys and belts. Cone pulleys were substituted for the gear changes for securing various speeds and feeds, and these cone pulleys were superseded by more and more complicated gear boxes which provided a multiplicity of changes, both in feed and speed, and also provided



This machine, built up of 4 verticle and 4 horizontal heads arranged about a 6 position automatic indexing table, equipped with 6 stationary type fixtures, performs a total of 134 operations on 90 blocks per hour.

means for disengaging the power connection between the driving pulleys and the spindle.

So far, drilling was confined to producing one hole at a time, but the ever increasing demand for lower costs and faster production brought about the use of small heads carrying several spindles, and arranged to mount in the spindle of a single spindle machine. These drill heads were a considerable advance in the way of production drilling. However, they had limitations, as the spindles were not adjustable with relation to each other, and the machines on which the drill heads were installed were of limited capacity.

In order to provide for high production and flexibility of arrangement of the position of the drills, multiple drilling machines were developed which had a travelling head, carrying a gear box, and providing a number of universal joint drives which could be applied to spindles mounted adjustably on the lower part of the head. Still later developments provided for changing the speed of each of these individual spindles independently. These two developments came about the time of the first automobile production, and were extensively used in the automotive industry for high production work.

About this same time, the increasing demand for lower cost and higher production, brought about the application of the same type of equipment to drilling from more than one direction. Up to this time, practically all of the drilling was done vertically. If holes were desired in a part from different sides, the part was turned over and passed to different positions under the head of the machine, or from one machine to another. This was accomplished by using rotating tables on which more than one fixture holding part was mounted, the parts being rotated with the table from one position to another under a vertical head. In the case of large parts, machines were set up in a line, and the fixture was mounted on a track and carried from one machine to the next, being turned over as required so as to operate on the various sides. This method of drilling from various sides is still in use to a certain extent, but on high productive jobs, the more up-to-date method is to drill from two or more sides in what is commonly known as a "Way Machine." Sometimes, these machines are simple two or three way machines which are placed along side of, or across the shop conveyor. Occasionally, the production will justify still more complicated machines, drilling from five or six different directions.

Our early mechanics realized the desirability of having power feed drilling machines with more flexibility in the rates of feed obtainable than could be secured by gear changes. Patent office records show that a great number of attempts were made to secure this flexibility by means of air and hydraulic applications through the use of cylinders connected to the drill feed mechanism. These early attempts, while clearly indicating a demand for improved drill feeding means, were unsuccessful from a practical standpoint, due principally to a lack of knowledge of hydraulics as applied to this kind of work, and to the crude control equipment available. The early attempts to apply hydraulics utilized water pressure from city water systems or from the plant system. Some years ago, developments in oil pumps of small volume capacity and high pressure, and a better understanding of control valve construction made it practical to apply this form of hydraulic control to drilling equipment. The possibility of securing an unlimited variation in the feeds, a rapid movement to and from the work, and an automatic cycle, made this type of feeding mechanism increasingly popular.

We now have hydraulically operated machines, in which one pump supplies feeding power for several heads, and also another system in which each head is supplied with hydraulic power from its own pumping system.

The development of small size efficient pumps, and compact valve design, has made it possible to

(Continued on page 56.)

CUTTING TOOL TESTS And Their SIGNIFICANCE

By CARL W. HORACK,
MEMBER A.S.T.E
Associate in Mechanical Engineering, University of California, Berkeley

The great majority of operations for which the Tool Engineer must plan involve the removal of metal in one form or another. Many types of tools are required and used for the various metal cutting operations. In this age of keen competition, the design of most tools and their use must be based on certain fundamental principles.

Many of the existing tools of today have been brought to their present state of perfection by gradual improvement over a period of time; others have been improved by making use of the results of well planned experiments and research. The latter method should yield quicker and more accurate results; but is usually considered more expensive, since the cost generally appears as a direct expense. When an operation or tool is improved after having been in production for a certain length of time, the expense of improvement still remains in the loss of production during the time in which the tool was used in its semi-perfect condition. The improper choice of machine, speed, feed and depth of cut add to the loss in efficiency in many cases.

There are, of course, certain manufacturing industries where many productions can be developed only gradually. Such conditions exist where new model machines must be gotten into production in a limited amount of time in order to have it on the market at a predetermined date. Extensive experimenting in such cases would cause expensive delays.

Such fundamental operations as turning, drilling, milling and to some extent grinding, reaming and tapping have been investigated from many angles. It has been said by some investigators that the cutting of metals may be considered a real science. There is, no doubt a great deal of truth in this statement, but so far the application of this science has been retarded by the complexity of the many factors involved.

However, many relationships between the various factors involved in metal cutting have been fairly well established, as the result of much experimental work. The following are probably a few of the ones most commonly known.

1. The relationship between cutting pressure, feed and depth of cut—expressed by the equation $P=CxD^nxF^m$.
2. The tool life varies with the cutting speed according to the equation, $V.\ T^n=C$, where V= the cutting speed in feet per minute.
   T=the tool life in min.
   C=a constant which depends on shape and size of tool, work and tool material, feed and depth of cut.
   n=a constant.
3. With constant chip area, the cutting speed for a given tool life can be greater for deep cuts and light feeds than for shallow depths and heavy feeds.
4. Cutting pressure and cutting temperature vary with the feed and depth, assuming a constant chip cross-section.
   a. More heat is developed with large feed and shallow depth than with the reverse condition.
   b. On the other hand, cutting pressure increases faster with increased depth of cut than with increased feed.
   c. Large depths and small feed preserve the cutting edge more and allow higher speeds for a given tool life or longer tool life at a given speed; however cutting pressure and power consumption increase.
5. Chip volume increases more with increasing depth than increasing feed.
6. Energy required to remove a given quantity of metal is less when cutting with a heavy chip than when taking a cut of small cross-section.

In using any of the results of metal cutting tests the fact should not be overlooked, that it is not always possible to obtain simultaneously maximum efficiency in the use of a tool and the machine in which it is used.

Very often a highly efficient tool is used in a machine that is more or less out of date or is not in perfect condition; again the reverse may occur. In either case the operation is not being performed efficiently. This may happen when a stellite or tungsten carbide tool is used in a machine that would hardly force a good high carbon or perhaps a high speed tool to its limit of usefulness. In such cases it would be much more economical to use lower priced tool materials.

Most of the available information in this field has been obtained from the published results of experiments conducted by various technical and scientific institutions. The classic work of F. W. Taylor, "On the Art of Cutting Metals," will of course remain the pioneer monument in this field. No doubt, a considerable number of individual manufacturers have undertaken similar experiments, but the results have not been made public.

Anyone who has supervised such experimental tests will appreciate the time and expense involved, especially in technical institutions where funds are limited and where the only reward consists in the satisfaction of having contributed some new information to the industry.

An example of how the results of some of these experiments may be applied in the design of metal

(Continued on page 65.)

PRODUCTION
Valve-Seat Grinding

BY ERNEST A. HALL, Member A.S.T.E.
PRESIDENT, THE HALL MANUFACTURING COMPANY, TOLEDO, OHIO

Hardened valve seats have demanded new methods for grinding to precision limits. This demand has resulted in the development of Eccentric Valve Seat Grinders which have been adopted by the majority of manufacturers throughout the world. In addition to grinding hardened seats, cast-iron seats are now being ground by manufacturers with lapping practically eliminated.

The Ford Motor Company grind over 100,000 valve seats per day. Plymouth Motor Company were the first passenger car plant to adopt eccentric grinding. Precision can be maintained not to exceed a thousandth of an inch. It depends entirely upon the man in charge of the Grinding Department as to the results obtained. Careful setting of the tools and checking of Eccentric Shafts and Pilots result in continued accuracy.

A production of 110 six cylinder blocks per hour grinding all twelve seats has been obtained by Plymouth Motor Company with four triple spindle setups and four men doing the grinding.

Today they are demanding even greater speed and one of the leading factories has placed an order for multiple six spindle grinders—two of which will be operated by two men—grinding 240 to 280 blocks per hour. This multiple machine has been in the making for about eighteen months and is just about ready for delivery. Valve seats must come to these machines free of grease and dry. Pilots should really be used only once and then washed free of abrasive to eliminate abrasive from going up into the Eccentric Shaft causing a lapping operation and wear.

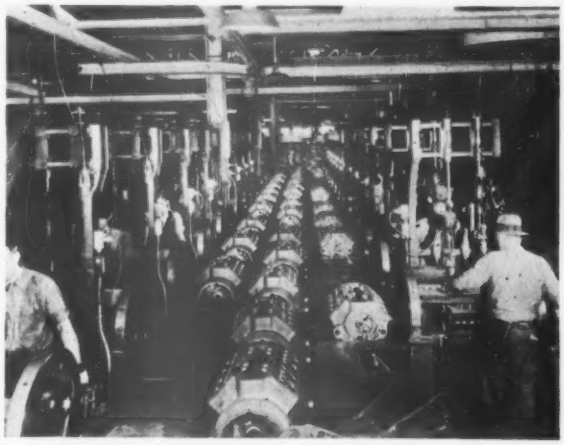
The Ford valve seats have to be held to a depth plus concentricity—therefore a stop limit on the machine is necessary which comes in contact with a definite length pilot which in turn goes down through the valve guide and rests on a hardened shaft which is slid into the cam shaft bearings. With this stop limit lever they can grind from three to seven thousandths of stock as desired. The limit is one thousandths of an inch of concentricity and two thousandths of an inch in depth.

Grinding of Stellite is an entirely different proposition—especially No. 1 Stellite. In this case it is necessary to dress the grinding wheel in between the roughing and finishing operation for every seat, whereas on the majority of other hardened steel inserts the wheel is dressed once every thirty or sixty seats—according to the demand. Some manufacturers use an alloy steel seat that is tough—if not hard. This seat gives considerable production trouble and demands an excessive dressing of the grinding wheel and usually gives a poor finish. Valve seats should be 52 Rockwell in hardness to eliminate the set that is liable to take place in the insert causing it to come loose. The seat should be of such an alloy that it is free cutting. Some softer valve seats can be cut nicely by the use of lamb's tallow being rubbed on the wheel which eliminates loading of the wheel.

Portable hand Eccentric Grinders are also being used by manufacturers for small production and for salvage work on the line. Some of these are equipped with high cycle motors which eliminate the danger of shock caused by short circuit due to grinding materials loading on brushes.

Eccentric Grinders have been adopted by thirty-six manufacturers in practically all the leading countries throughout the world and are used on Diesel engines—grinding seats up to 7½" in diameter.

On airplane engines a new Eccentric Grinder has been designed that will handle the angular valve seats in the bottom of the cylinder. In this case the pilot is inserted from the outside through the guide after the grinder has been lowered down into the seat. In all cases it is necessary to have a man with considerable experience and intelligence to handle valve seat grinding as it is now being done.



Production Valve Seat Grinding Line at Ford Plant showing each operator grinding all sixteen seats while block is held in fixture.

LIST OF EXHIBITORS AND EXHIBITS

MACHINE TOOL SHOW

CLEVELAND PUBLIC AUDITORIUM

September 11-21, 1935

MACHINE TOOL SECTION:

(By Members of the National Machine Tool Builders' Association)

Exhibitor	Booth No.	Exhibit
A		
Acme Machine Tool Co. Cincinnati, Ohio	109-a	Turret Lathes.
Abrasive Machine Tool Co. East Providence, R. I.	405	Surface Grinding Machines and Accessories
Acme Machinery Co. Cleveland, Ohio	311	Bolt Threading and Nut Tapping Machines.
Ajax Manufacturing Co. Cleveland, Ohio	"F"	Forging Machine—Wire Drawing Devices.
Charles G. Allen Co. Barre, Mass.	15	Drilling and Tapping Machines.
American Broach & Machine Co. Ann Arbor, Michigan	1005	Hydro Mechanical Broaching machines and tools
The American Tool Works Co. Cincinnati, Ohio	901	Lathes; radial drills; shapers
Arter Grinding Machine Co. Worcester, Mass.	108	Hydraulic surface grinding machines; Auto piston ring grinding mach.
The Avey Drilling Machine Co. Cincinnati, Ohio	18	Sensitive drilling and tapping machines; drilling units; cutting off machines.
B		
Baker Bros., Inc. Toledo, Ohio	307-b	Drilling, broaching, grinding machines.
Barber-Colman Co. Rockford, Ill.	903	Hobbing machines; taper spline, precision gear hob sharpening machine, milling cutters, hobs, reamers.
Barnes Drill Co. Rockford, Ill.	201	Drilling machines; tapping machines; honing machines.
W. F. & John Barnes Co. Rockford, Ill.	304-a	Vert. & Horiz. drilling and boring machines automatic lathes.
Charles H. Besly and Co. Chicago, Ill.	1	Flat surface grinding machines, abrasive discs.
The Blanchard Machine Co. Cambridge, Mass.	309	Surface Grinding machines.
The Bridgeport Safety Emery Wheel Co. Bridgeport, Conn.	25	Grinding and polishing machines.
Brown & Sharpe Mfg. Co. Providence, R. I.	27	Milling machines, grinding machines, screw machines, gear cutting machine, Cutters, hobs, pumps, arbors, machine attachments.
Bryant Chucking Grinder Co. Springfield, Vt.	203	Internal grinding machines.
Buffalo Forge Co. Buffalo, N. Y.	111	Drilling mach., punches and shears bending rolls.
Buhr Machine Tool Co. Ann Arbor, Mich.	308	Drilling machines, power drilling units, mult. drill heads and accessories.
The Bullard Co. Bridgeport, Conn.	205	Turret lathes—vert. single spindle auto. lathes
C		
The Carlton Machine Tool Co. Cincinnati, Ohio	904	Radial drilling machines.
The Cimatool Co. Dayton, Ohio	108-b	Boring machines, gear chamfering & burnishing mach; "Sheffield" gages.
The Cincinnati Bickford Tool Co. Cincinnati, Ohio	406	Radial drilling machines.
The Cincinnati Lathe & Tool Co. Oakley, Cincinnati, Ohio	11	Engine lathes & attachments.
The Cincinnati Milling Mach. Co. Cincinnati, Ohio	207	Milling mach., grinding mach., broaching mach.
The Cincinnati Shaper Co. Cincinnati, Ohio	603	Shapers, shears.
The Cleveland Automatic Mach. Co. Cleveland, Ohio	20	Chucking mach., multiple spindle and single spindle bar machines.
Cleveland Hobbing Machine Co. Cleveland, Ohio	301	Hobbing machines.
Cone Automatic Mach. Co., Inc. Windsor, Vt.	"A-B"	Auto Screw machines, chucking machines.
D		
Davenport Machine Tool Co. Rochester, N. Y.	1006	Automatic screw mach.
DeVlieg Milling Machine Co. Jackson, Mich.	8	Milling machines, milling units.
Diamond Machine Co. Providence, R. I.	605	Surface grinding machine.
The Dreses Machine Tool Co. Cincinnati, Ohio	30	Radial drills.
E		
The Eastern Machine Screw Corp. New Haven, Conn.	900	Threading mach., chaser grinders, die heads, chasers.
Erie Foundry Co. Erie, Pa.	22	Electric air board drop hammer.
Ex-Cell-O Aircraft & Tool Corp. Detroit, Mich.	812	Grinding and finishing mach., precision boring mach., counterbores, broaches.
F		
Farrel-Birmingham Co., Inc. Buffalo, N. Y.	105-a	Gear generators, gear lapping mach., cutters.
The Fellows Gear Shaper Co. Springfield, Vt.	305	Gear shapers, gear lapping machines, gear measuring machines.
The Foote-Burt Co. Cleveland, Ohio	912	Drilling and boring machines, surface broaching machines.
The Fosdick Machine Tool Co. Cincinnati, Ohio	1004	Radial drilling mach., upright drilling mach., sensitive drilling mach.
Foster Machine Co. Elkhart, Ind.	200	Turret lathes, automatic chucking mach., screw mach., wrenchless chucks.
G		
Gallmeyer & Livingston Co. Grand Rapids, Mich.	307	Surface grinding mach., tap grinders.
The Geometric Tool Co. New Haven, Conn.	103	Threading mach., chaser grinders & attachments, die heads, collapsible & solid taps.
Giddings & Lewis Mach. Tool Co. Fond du Lac, Wisc.	110	Horiz., boring, drilling, and milling machines.
Gisholt Machine Co. Madison, Wisc.	112	Turret lathes, automatic lathes, single point tool grinders, balancing machines, tools & access.
Gleason Works Rockester, N. Y.	811	Gear cutting mach., spiral beval and hypoid, straight pinion cutting mach., tool sharpening mach., gear testing mach.
Gearge Gorton Machine Co. Racine, Wisc.	"H"	Pantograph mach., milling mach., duplicating machines.
The Goss & De Leeuw Mach. Co. New Britain, Conn.	1008	Auto chucking machines.
Gould & Eberhardt Irvington, Newark, N. J.	"E"	Shapers, gear hobbing machines, gear cutting machines.
G. A. Gray Co. Cincinnati, Ohio	1012	"Gray" milling planer.
Green Bay Barker Mach. & Tool Wks. Green Bay, Wisc.	4-a	Drilling machines.
Greenlee Bros. & Co. Rockford, Ill.	902	Automatic screw mach., 4-spindle, way type drilling mach., multiple spindle drilling mach. drive units.
H		
The Hall Planetary Co. Philadelphia, Pa.	14	Thread and form milling mach., cutter heads and cutters.
Hannifin Manufacturing Co. Chicago, Ill.	104	Spec. hydr. & pneumatic mach., presses, hydr. air oper. pneumatic and hydraulic valves, air operated chucks and workholding devices.
The Hanson-Whitney Mach. Co. Hartford, Conn.	404	Milling mach., hob thread die shaping mach., centering mach., small tools and gages.
The Heald Machine Co. Worcester, Mass.	206	Grinding mach., & accessories, precision boring mach. and accessor.
The Hendey Machine Co. Torrington, Conn.	402	Lathes, shapers, univ. high speed—heavy duty.
Hoefer Mfg. Co. Inc. Freeport, Ill.	12	Drilling machines, drill heads, drilling units.
Hutto Engineering Co. Inc. Detroit, Mich.		Honing mach., gear lapping machine, honing equipment.
I		
Illinois Tool Works Chicago, Ill.	303	Die filing-gear hobbing and testing-milling cutters, hobs, broaches, reamers, washers, screws.
The Ingersoll Milling Machine Rockford, Ill.	810	Milling, boring and drilling machines.

Exhibitor	Booth No.	Exhibit
J		
Jones & Lamson Machine Co. Springfield, Vt.	607	Turret lathes, automatic lathes, milling and centering machine, screw thread equipment, comparator.
K		
Kearney & Trecker Corp. Milwaukee, Wisc.	400	Milling mach., knee and bed type, cutter grinding machines.
Kent-Owens Machine Co. Toledo, Ohio	105	Milling machines, arbors.
King Machine Tool Co. Cincinnati, Ohio	910	Vertical boring and burning machines.
Kingsbury Machine Tool Corp. Keene, N. H.	1009	Drilling and tapping machine, drilling and tapping units.
W. B. Knight Machinery Co. St. Louis, Mo.	19	Vertical milling machines.
L		
Landis Machine Co. Waynesboro, Pa.	204	Threading mach., single head, pipe threading and cutting mach., forming and threading mach., die heads, taps, chaser grind.
Landis Tool Co. Waynesboro, Pa.	"J-K"	Precision grinding mach.
The Lapointe Machine Tool Co. Hudson, Mass.	"D"	Broaching machines and tools.
The R. K. LeBlond Mach. Tool Co. Hyde Park, Cincinnati, Ohio	1001	Lathes.
Lehmann Machine Co. St. Louis, Mo.	312	Engine lathes.
Leland-Gifford Co. Worcester, Mass.	403	Sensitive drilling mach., tapping machines.
The Lodge & Shipley Mach. Tool Co. Cincinnati, Ohio	1018	Lathes.
The Logansport Machine Co. Logansport, Ind.	313	Air and hydr. operated arbor & forcing presses, hydraulic power device, chucks, air and hydraulic cylinders control valves.
The Lucas Machine Tool Co. Cleveland, Ohio	202	Horizontal boring, drilling and milling machine.
M		
Mattison Machine Works Rockford, Ill.	302	Surface grinding machines.
Monarch Machine Tool Co. Sidney, Ohio	813	Engine lathes and automatic lathes.
Murchey Machine & Tool Co. Detroit, Mich.	209	Bolt and threading machines, self opening die heads, collapsing taps.
N		
National Acme Co. Cleveland, Ohio	601	Automatic screw mach., centrifugal separators, dies, taps, chronolog.
National Machinery Co. Tiffin, Ohio	23-a	Tapping machines.
New Britain-Gridley Mach. Co. New Britain, Conn.	909	Automatic chucking machines, automatic screw machines.
Norton Company Worcester, Mass.	101	External cylindrical tool room, and surface grinding machines.
O		
The Ohio Machine Tool Co. Kenton, Ohio	13	Shapers.
The Oilgear Company Milwaukee, Wisc.	5	Broaching mach., assembling presses, M T feed pumps, var. speed trans.
Oliver Instrument Co. Adrian, Mich.	208	Drill grinders die making mach., cutter grinders, tap grinders.
The Oster Manufacturing Co. Cleveland, Ohio	7	Threading machines, pipe and bolt.
P		
Peerless Machine Co. Racine, Wisc.	4	Metal sawing machines.
The Porter-Cable Machine Co. Syracuse, N. Y.	307-c	Disc and belt grinding machines.
Potter & Johnston Machine Co. Pawtucket, R. I.	602	Automatic chucking machines.
Pratt & Whitney Co. Hartford, Conn.	506	Lathes, vertical shapers, jig boring mach., hydr. vert. surface grinding mach., gear grinding mach., die sinking mach. cutter grinding machine, (Keller type) small tools, gages.
The Producto Machine Co. Bridgeport, Conn.	307-a A-301	Milling mach., (die sets and acces. for presses shown in access. sect.)
R		
Racine Tool and Machine Co. Racine, Wisc.	106	Metal cutting machines, hydraulic pumps.
Reed-Prentice Corp. Worcester, Mass.	"C"	Lathe, geared head, vert. milling mach., die sinking mach., die casting machines.
Rivett Lathe & Grinder Inc. Boston, Mass.	1010	Lathes, bench precision, millers, bench grinders, internal external precision lubricating system.
Rockford Machine Tool Co. Rockford, Ill.	310	Shapers, shaper-planers.
S		
Wm. Sellers & Co. Inc. Philadelphia, Pa.	401	Horiz. boring machines, tool grinding mach., drill grinding mach., milling heads.
Seneca Falls Machine Co. Seneca Falls, N. Y.	914	Automatic lathes, automtaic work drivers, automatic work handling devices.
The Sidney Machine Tool Co. Sidney, Ohio	1011	Toolroom lathes, engine lathes.
Springfield Machine Tool Co. Springfield, Ohio	800	Lathes.
Sundstrand Machine Tool Co. Rockford, Ill.	306	Automatic lathes, tool grinders, milling mach.
T		
The Taylor & Fenn Co. Hartford, Conn.	504	Milling mach., grinders, internal sensitive drilling machines.
The Thompson Grinder Co. Springfield, Ohio	24	Surface grinders.
The Toledo Pipe Threading Mch. Co. Toledo, Ohio	108-c	Pipe threading machine.
U		
The United States Elec. Tool Co. Cincinnati, Ohio	102	Grinding and polishing machines, portable hand tools (drills, sanders, polishers, grinders).
Universal Boring Machine Co. Hudson, Mass.	304	Boring, drilling and milling machines.
V		
Van Norman Machine Tool Co. Springfield, Mass.	913	Milling machines, oscillating radius grinders.
W		
O. S. Walker Co. Inc. Worcester, Mass.	3	Surface grinding mach., magnetic chucks.
The Warner & Swasey Co. Cleveland, Ohio	905	Turret lathes.
Whitney Metal Tool Co. Rockford, Ill.	16	Punches and shears, angle iron machinery, press brakes.

ACCESSORIES AND RELATED MACHINE SHOP PRODUCTS

Exhibitor	Booth No.	Exhibit
Acme Machine Products Co. Inc. Muncie, Ind.	A-312	Capscrews and nuts.
Air Reduction Sales Co. New York, N. Y.	A-412	Welding and cutting apparatus.
Ahlberg Bearing Co. Chicago, Ill.	E-301	Anti friction ball and roller bearings.
The Louis Allis Co. Milwaukee, Wisc.	E-411	Motors.
Allis-Chalmers Mfg. Co. Milwaukee, Wisc.	E-401	Electric motors and accessories.
American Chain Co., Inc. Bridgeport, Conn.	A-305	Chain and flexible belts.
Armstrong Bros. Tool Co. Chicago, Ill.	A-304	Lathe and planer tools, wrenches.
Baker-Raulang Co. Cleveland, Ohio	E-212	Crane trucks.
Barrett-Cravens Co. Chicago, Ill.	E-501	Lift trucks, skids, elevators, barrel and storage racks.
Leon J. Barrett Co. Worcester, Mass.	A-408	Centrifugals and oil extractors.
Bausch & Lomb Optical Co. Rochester, N. Y.	A-309	Microscopes—metallurgical, toolmakers, measuring, gages, optical instruments.
John Bath & Co. Inc. Worcester, Mass.	A-101	Ground thread taps; thread gages; roll threading dies.
The Black & Decker Mfg. Co. Towson, Md.	E-101	Portable electric drills, grinders, sanders, screw drivers and accessories.
G. S. Blakeslee & Co. Chicago, Ill.	E-202	Cleaning machine, alkali washers and solvent.

(*Continued on page 44*)

LAST CALL!

Get your reservations in now—
immediately — to go to the

MACHINE TOOL SHOW

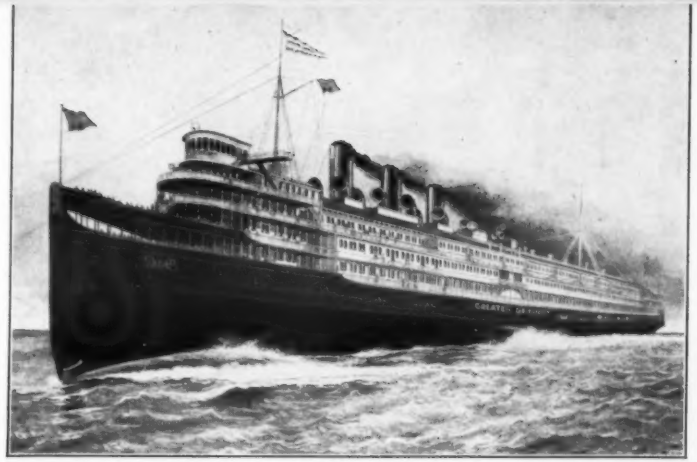
with the

American Society of Tool Engineers

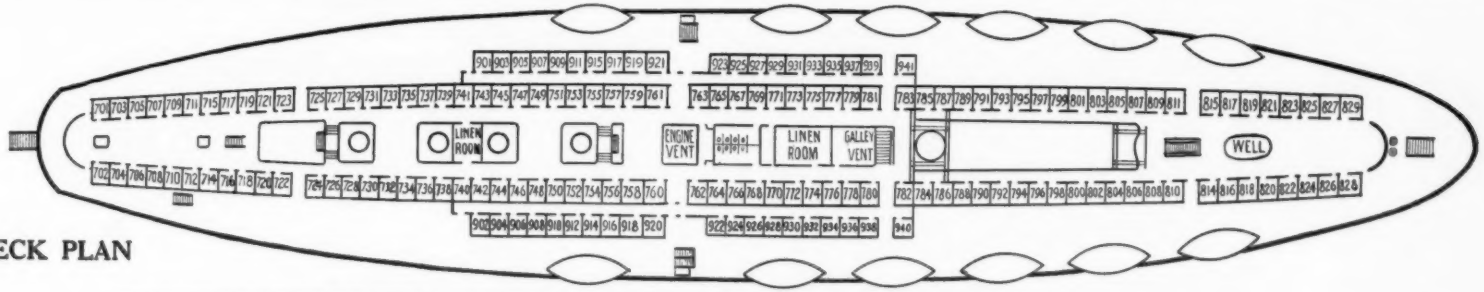
on the

S. S. GREATER DETROIT

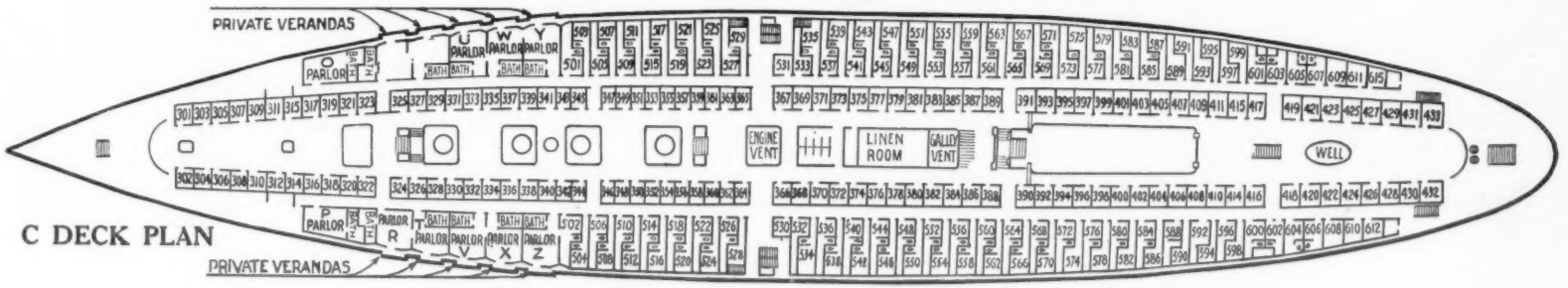
SEPTEMBER 12th. and 13th.



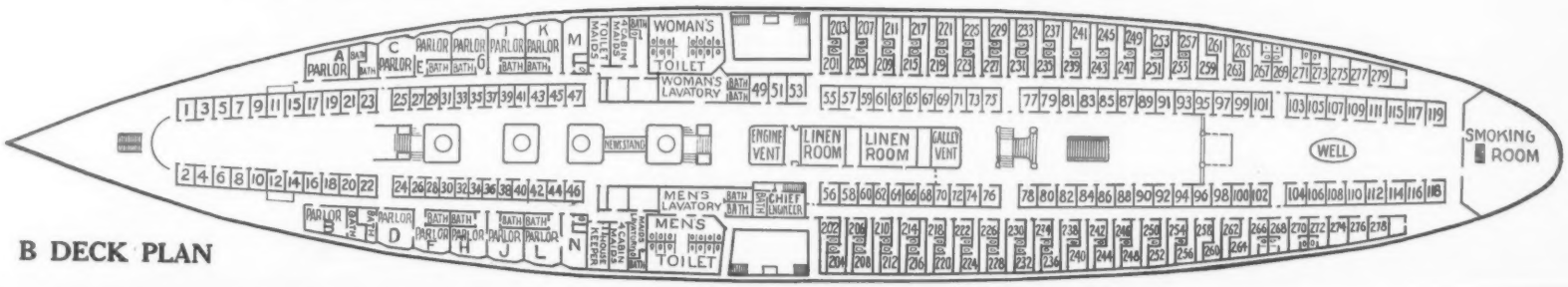
USE THIS COUPON NOW



D DECK PLAN



C DECK PLAN



B DECK PLAN

$10 ACCOMMODATIONS

Base Price $10.00 includes transportation on the steamer to and from Cleveland breakfast on board Friday morning, Sept. 13th, entrance and registration to the Machine Tool Show, Banquet and admittance to A.S.T.E. Technical Session, Hotel Statler, Friday Evening, Sept. 13th, souvenirs, etc. Also berth accommodations as follows:

56 Single inside rooms (will sleep only one person)†

Room numbers: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365.

190 Double inside rooms. These will not be sold as singles. (will sleep 2 or 3 persons—double lower and single upper berths)†

Room numbers: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 42, 43, 46, 47, 55, 56, 57, 58, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 114, 115, 316, 317, 318,, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 414, 415, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782 783, and 416.

† These accommodations included in the $10.00 trip.

DELUXE ACCOMMODATIONS, SLIGHT EXTRA COST

Additional accommodations are available at nominal costs in addition to the $10.00 base for the trip.

	To $10 Base Price Add
214 Outside Double Rooms, will sleep 2 or 3, double lower and single upper berths	**$2.00**

Room numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 116, 117, 118, 119, 240, 241, 244, 245, 248, 249, 252, 253, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 274, 275, 276, 277, 278, 279, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 314, 315, 430, 431, 432, 433, 528, 529, 530, 531, 532, 533, 574, 575, 578, 579, 582, 583, 586, 587, 588, 589, 590, 591, 592, 593, 595, 596, 597, 598, 599, 608, 609, 610, 611, 612, 615, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 784, 785, 786, 787, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912,, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, and 941.

126 Outside rooms with toilet **$4.00**

Room numbers: 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 242, 243, 246, 247, 250, 251, 254, 255, 270, 271, 272, 273, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 534, 535, 536, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 576, 577, 580, 581, 584, 585, 604, 605, 606, 607, and 537.

All state rooms, with the exception of the 56 single inside rooms, consist of double lower and single upper berths — accommodating two or three people.

8 rooms with shower and toilet **$6.00**

Room numbers: 266, 267, 268, 269, 600, 601, 602, 603.

PARLORS	Cost of parlor regardless of number of persons occupying same

2 parlors, double beds, special, with toilet **$15.00**

The $15 price is for these parlors which will accommodate 2 persons. Cost per person, including the $10 base price is $17.50. Parlor Numbers M and N.

2 parlors, twin beds, tub and shower bath **$17.00**

The $17 price is for these parlors which will accommodate 2 persons. Cost per person, including the $10 base price is $18.50 Parlor Numbers E and F.

12 parlors, twin beds, tub and shower bath, couch **$20.00**

The $20 price is for these parlors which can accommodate 3 persons (one sleeping on couch). For the two persons which this parlor will normally accommodate the rate per person will be $20—including the base price of $10. Parlor Numbers A, B, C, D, G, H, I, J, K, L, O, P.

7 parlors, twin beds, tub and shower bath, couch and veranda **$25.00**

The $25 price is for these parlors which can accommodate 3 persons (one sleeping on couch). For the two persons which this parlor will normally accommodate the rate per person is $22.50—including the base price of $10. Parlor Numbers R, U, V, W, X, Y, and Z.

1 parlor, twin beds, tub and shower bath and veranda **$25.00**

TEAR OUT THIS FORM AND MAIL NOW!

American Society of Tool Engineers
31 Melbourne
Detroit, Michigan

IMPORTANT

EVERY Ticket holder must be registered by Name, Company and position. List below, or enclose this information with your application.

Dear Sir:
Please reserve Room Number(s) ..... **or parlor(s) Number** ..... **for** ..... **persons on the A.S.T.E. Cleveland trip, Greater Detroit, September 12-13, 1935. I enclose** ..... **in the amount of $** ..... .
(check, M. O., cash)

Signed .....

Company ..... **Position** .....

Send tickets to me at .....

City ..... **State** .....

For further information call MA2057

Lasting Dividends

— in —

Advancement, pleasure and good fellowship for an investment as low as

$10

Base Price

Pick out the accommodations you desire from boat plans and information above — then send in your reservation immediately.

NOTE: ***In case of emergency refunds on reservations will be made up to 24 hours before sailing.***

A PREVIEW OF

CINCINNATI

23 Machines

BOOTH 207

Nos. 2 Plain, Universal and Vertical High Speed Dial Type Milling Machines . . . No. 3 Plain Medium Speed Dial Type with Motor Driven Universal Overarm Attachment . . . No. 2 Universal Milling Machine . . . Two No. 1-12 Plain Automatic Milling Machines . . . Nos. 3-24 and 5-48 Plain Hydromatics . . . 45-60 Three-Spindle Hydromatic . . . No. 2 Cutter and Tool Grinder . . . 6″ x 30″ Hydraulic Saddle Type Grinding Machine . . . 12″ x 72″ Universal Self-Contained Grinding Machine . . . 24″ x 144″ Roll Grinding Machine . . . Chucking Grinder . . . Two No. 2 Centerless Grinders . . . No. 3 Centerless Grinder . . . Centerless Lapper . . . Nos. 2-36 and 5-42 Hydro-Broach Machines . . . Hydro-Diematic . . . Hand Die-Sinking Machine.

A 5 STAR SHOW

September, 11th to 21st

inclusive

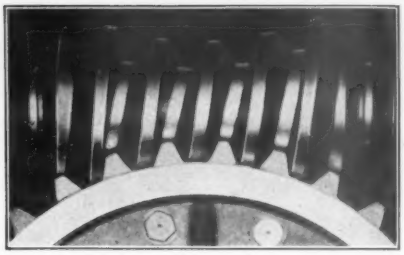
at Cleveland

THOUSANDS of Industrial and Business men will see 23 modern Cincinnati Machines in Booth 207 during the Machine Tool Show. They will see an unusual display of cost-cutting machines, representing five fields of manufacturing methods illustrated in this "Preview Of A 5 Star Show". They will see the newest—new in milling, grinding, lapping, broaching and die-sinking. They will discover new possibilities in cost-reducton, accuracy, productivity, ease and convenience of operation. They will see a 5 Star Show!

Plan now to join them. Use this "Preview" as a guide in our exhibit Booth 207.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI GRINDERS INCORPORATED
CINCINNATI, OHIO, U.S.A.

CONE AREA-CONTACT WORM GEARS NOW ON PRODUCTION BASIS



Now that complete and practical solutions of the cutting problems involved in the production of Cone Area-Contact Worm Gears have been reached, the amazing advantages of this ideal type of gear are available for wide application in industry.

The Cone Worm Gear, so named after its inventor, Samuel I. Cone, realizes in practice a principle long recognized as possessing important advantages, yet for many years impossible of production in quantity because no rational cutting method or practical tool equipment had been developed.

Continuous area contact over the

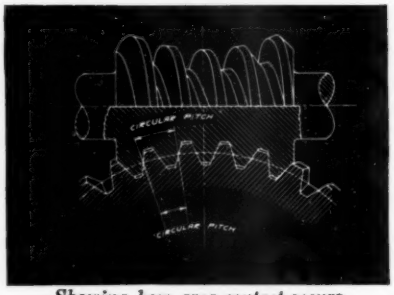
Line contact the full depth of teeth, as compared to point contact

full depth of the several meshing teeth has been achieved for the first time in the Cone Worm Gear, resulting in a long train of operating advantages.

Cone Worm Gears afford 30 times as much tooth area contact at a given time as the ordinary straight line type. The consequent distribution of pressure results in less wear, less heat generation, ideal lubrication, greater smoothness and silence, and a proved efficiency as high as 99.34%—the highest ever recorded.

Besides having the highest load-carrying capacity of any worm gear of a given size, Cone Area-Contact Worm Gearing in operation naturally provides a cushioning oil film. It wears in, instead of "wearing out," is free from pitting and operates at a lower cost per horse power transmitted than any other known worm gearing.

Furthermore, this gearing possesses a wider range of applications



Showing how area contact occurs simultaneously between worm flanks and all meshing wheel teeth

—continuous operation at 30,000 r.p.m.—intermittent operation at four revolutions per hour under extreme loads—gear ratios as high as 100 to 1 and as low as 1 to 1—are examples of standard conditions under which Cone Worm Gearing is operating.

The whole secret of the success of the Cone Area-Contact Worm Gear lies in the practicability of the method and the means by which it is manufactured: Automatic generation of both worm and wheel blanks without cutting away stock essential to the finished tooth form.

Production

Corner of Michigan Tool Company plant showing several types of Cone Area-Contact Worm Gears in production

With the solution of the apparently simple, but exceedingly intricate production riddle represented by Cone Area-Contact Worm Gearing, cutting tools and machines for both large and small scale production covering the complete range of sizes, gear ratios and capacities have been developed. This machinery is available for manufacturers who choose to set up their own production and is also installed as standard equipment for manufacture of gears by the Michigan Tool Company to supply customers' requirements.

Complete information covering technical data on Cone Area-Contact Worm Gears, as well as details relating to production, operation and applicability, will be gladly supplied in response to inquiry.

MICHIGAN TOOL COMPANY
DETROIT, MICHIGAN

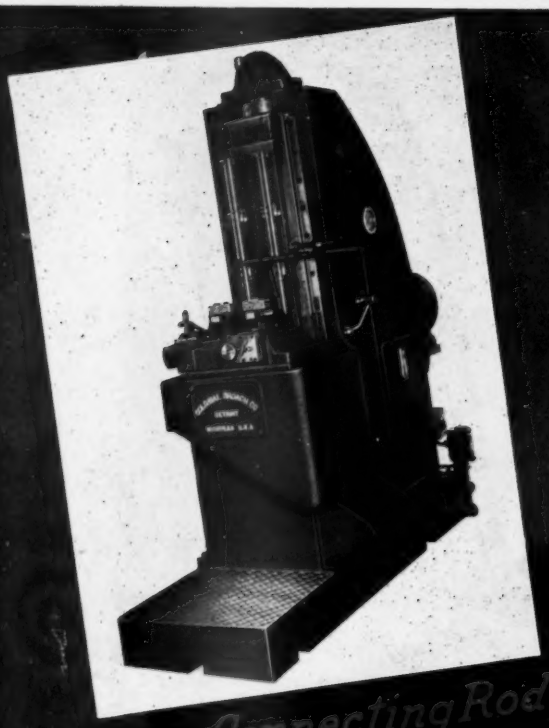
BOOTH 27

B·S

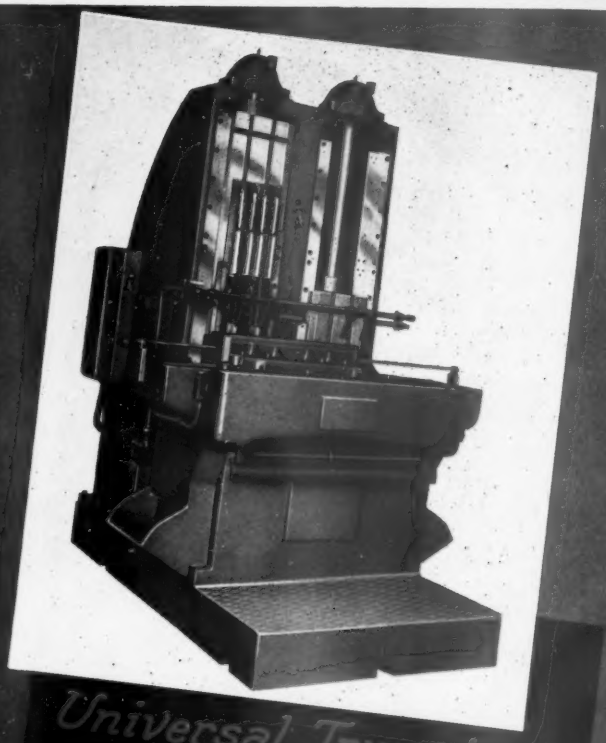
ON EXHIBIT— A representative line of modern, efficient, cost-cutting machine and tool equipment of vital interest to the manufacturer who requires accuracy of product at low unit cost. May we show you this equipment at Booth 27? Brown & Sharpe Mfg. Co., Providence, R.I., U.S.A.

BROWN & SHARPE

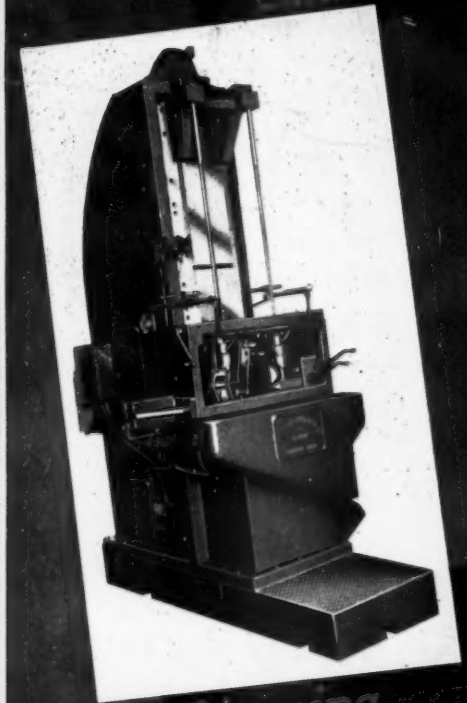
Colonial Broaching Machines



Connecting Rods



Universal Trunnions



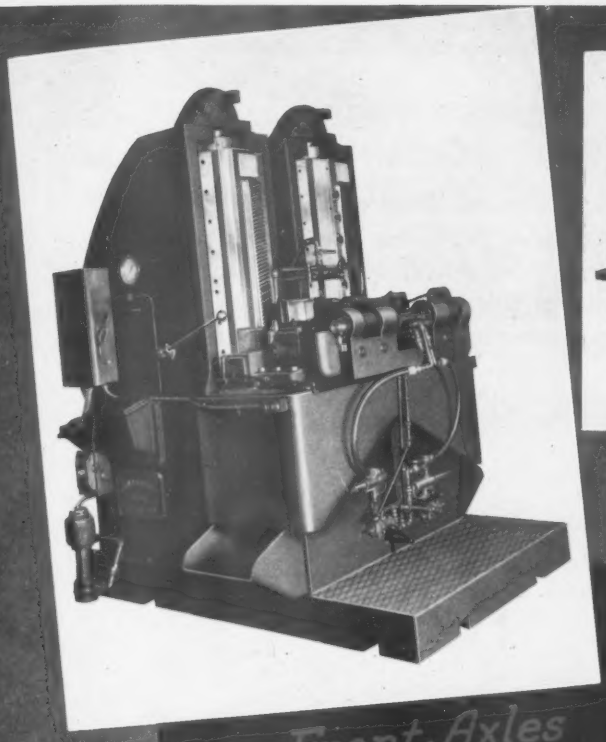
Steering Housings

Balancer Plates

Bearing Caps

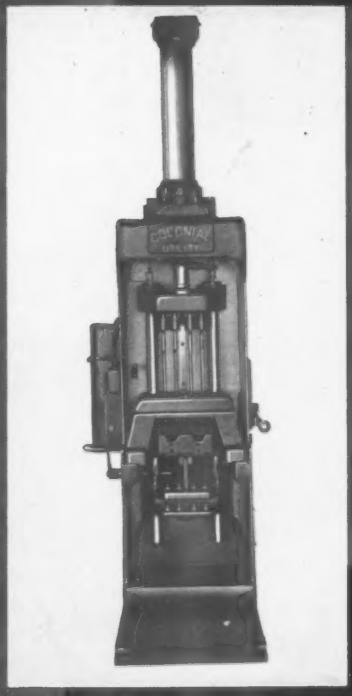
COLONIAL BROACH COMPANY DETROIT, MICH.

and Tools for every Purpose

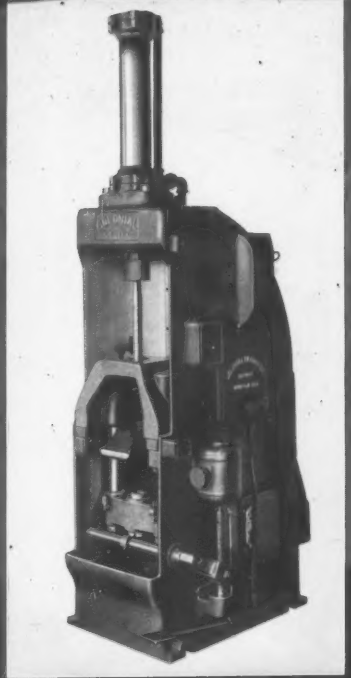


Front Axles

Cylinder Blocks



Valve Guides



Sizing Gears

Shifter Forks

COLONIAL BROACH COMPANY DETROIT, MICH.

SUPER STRENGTH RADIAL DRIVE COUNTERBORES

and ot

Developed for Maximum Production— at Minimum Operating Cost!

Rugged construction as a result of scientific design, combines maximum driving power, positive alignment and increased accuracy. The double drive mechanism, both in the holder and on the cutter, is integral and is machined from the solid. These modern features have advanced Radial Drive Counterbores rapidly to a foremost position in many of the largest production plants in the country.

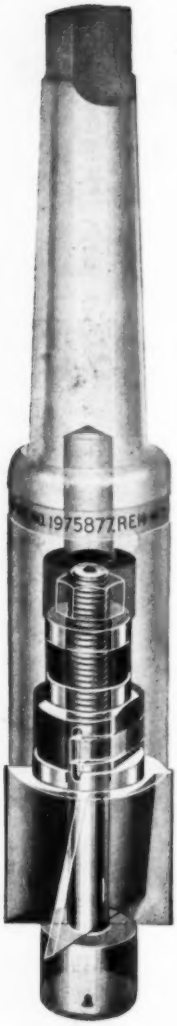


Fig. 1

The new Eclipse Radial Drive incorporates a previously unused practical principle for driving interchangeable tools—*direct on center line!* This simple construction will withstand greater overloading than other present day double interlocking drives.

The paired driving mechanism is arranged close to the cutting edges (minimizing torque) between accurately ground aligned surfaces. See illustrations, Fig. 1, 2, and 3.

Engineers, Production Managers and Purchasing Agents, not acquainted with the performance of these tools, owe it to their company to adopt Radial Drive Counterbores when efficiency and *real* economy are the deciding factors in the selection of interchangeable tools.

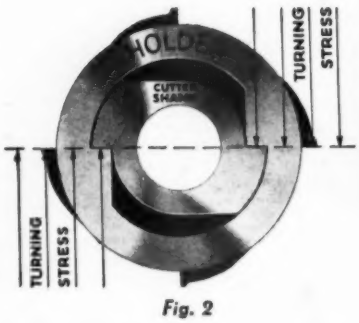
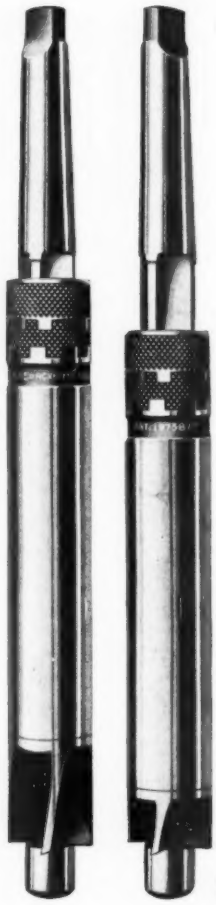


Fig. 2

Fig. 3



Quick Adjustable Stop Collar Holders. (Left) Holder locked in position. (Right) Showing method of adjustment and locking collars—entirely by hand.

Radial Drive .001 Adjustment Variable Length Holders. Instant Adjustment by hand.

ECLIPSE COUNTERB

DETRO

other

HIGH PRODUCTION END CUTTING TOOLS

The Value of Long Experience— Over Twenty-One Years' Concentration

on the development of interchangeable counterbores, spotfacers, two-piece core drills, and multi-diameter boring cutters, is reflected in the efficiency and economy of all tools bearing our trade-mark. . . . The Eclipse complete engineering and manufacturing organization is ready to assist in solving and economizing your end cutting tool problems. Send us your layouts and specifications—no obligation.

A FEW OF OUR STANDARD CARRIED-IN-STOCK PRODUCTION TOOLS ARE SHOWN HERE

Assembly of Balanced Drive Inverted Spotfacer, Pilot and Cutter.

Welch Plug Cutter. (Combines Core Drilling and Counterboring).

Interchangeable Countersink

Die Sinking Cutters, showing Angle Cutter, Ball Cutter, and End Mill.

Two-piece Core Drill.

Cemented Carbide Tipped Turning Tools. Practically every type of Eclipse fluted cutter can also be furnished with Cemented Carbide Tips.

Send for our new Catalog No. 35.

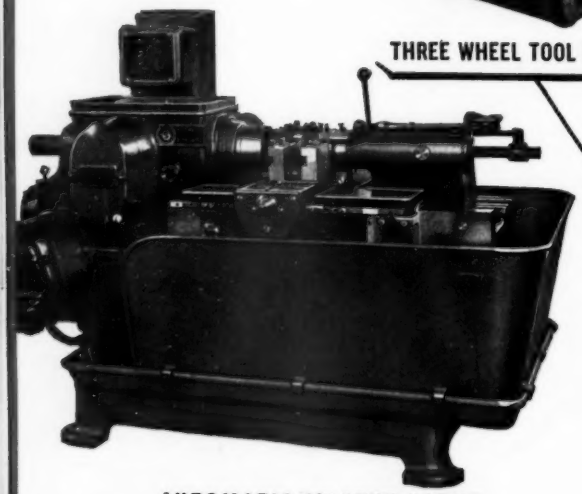
RBORE **COMPANY**

ROIT

Go to Cleveland SEPT. 11-21

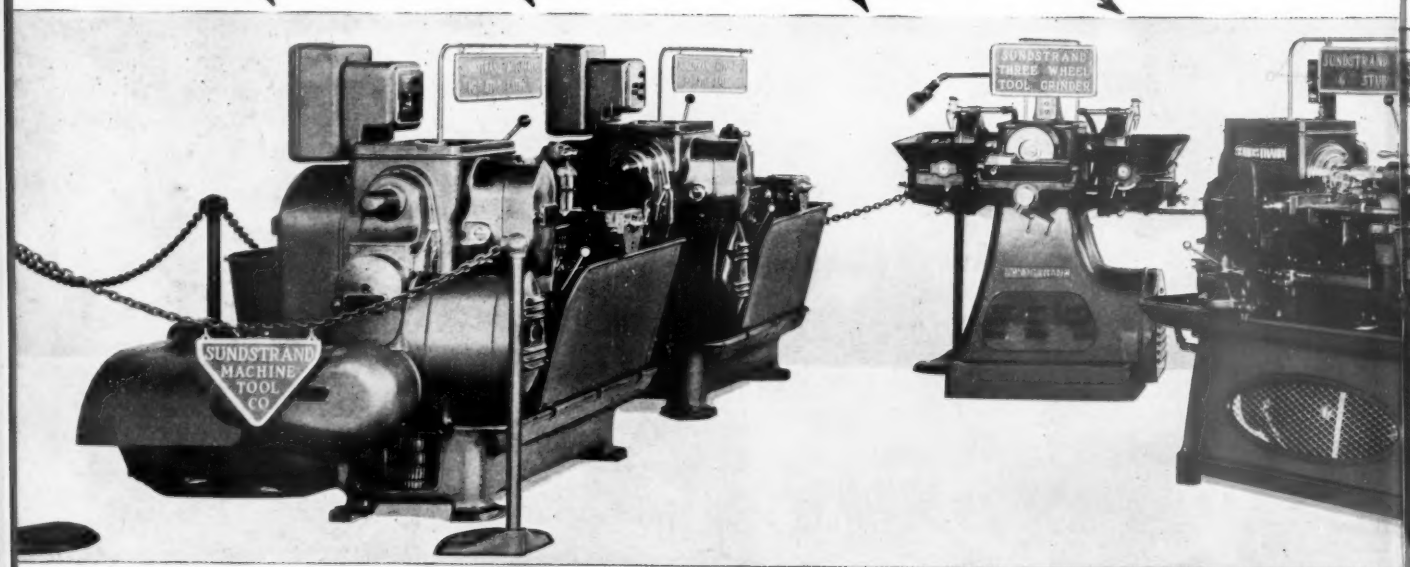
THREE WHEEL TOOL GRINDER

Months of careful planning, days and nights of toil, have been spent in preparing the Sundstrand exhibit for the Machine Tool Show. And we are ready! Ready to show three machines that will be new to you but familiar to us because they are built on principles that have taken years to develop. Marvels of simplicity, accuracy, speed, convenient operation, and durability; these new Sundstrand machines have many features and advantages



AUTOMATIC 10" STUB LATHE

AUTOMATIC 6" STUB LATHE



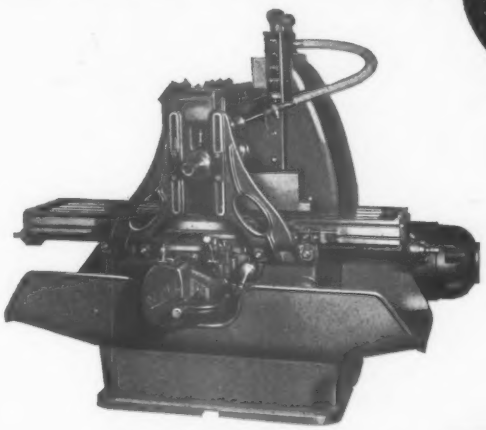
SEE OUR EXHIBIT IN BOOTH

No. 306

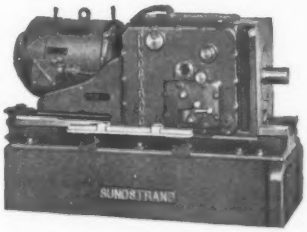
that point the way to new high records in production and new low costs, yet their purchase involves no unusually large investment of capital. There will be three other Sundstrand machines in our exhibit. These have been described and advertised in the trade papers during the past year but this will be the first time they have been displayed under power to the industry as a whole. Our exhibit is pictured below. Be sure to see it—Booth 306.

SUNDSTRAND MACHINE TOOL CO.

2530 ELEVENTH STREET, ROCKFORD, ILLINOIS, U. S. A.

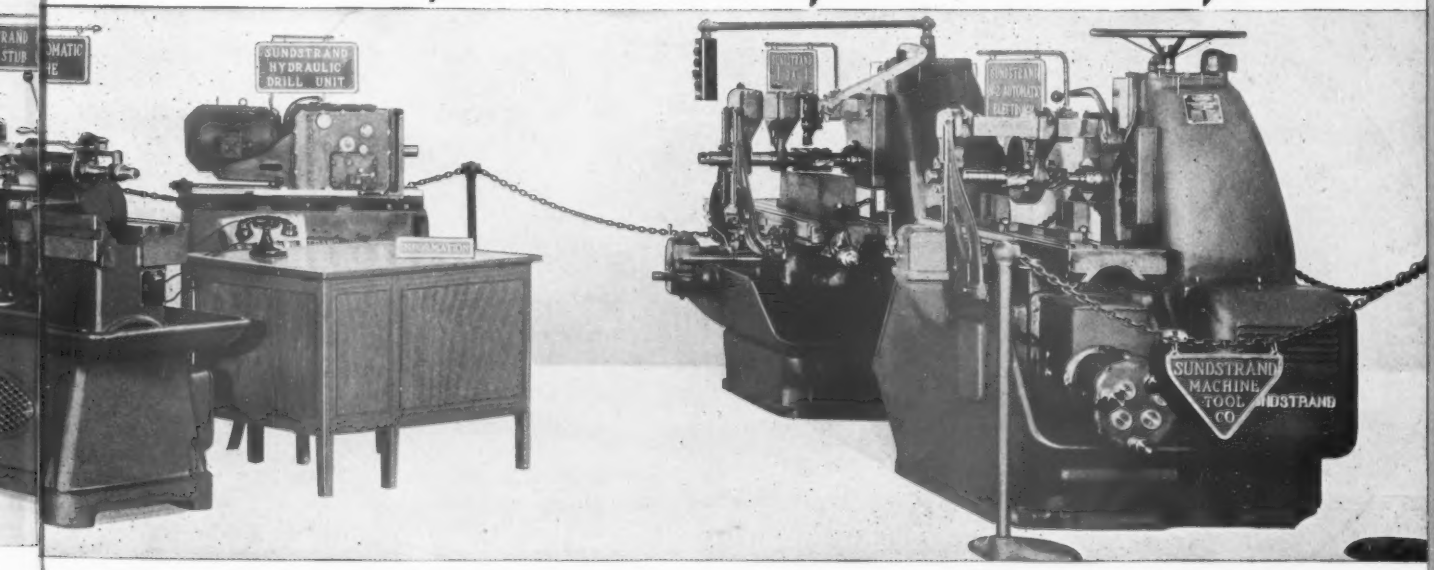


NO. 3A RIGIDMIL



HYDRAULIC DRILL UNIT

NO. 2 AUTOMATIC ELECTROMIL



See CARBOLOY* ACTION at the MACHINE TOOL SHOW CLEVELAND, SEPT. 10-21

HIGHER SPEEDS!

GREATER ACCURACY!

LONGER TOOL LIFE!

BETTER FINISH!

SAVING IN METAL!

LOWER COSTS!

Many OF THE LEADING MACHINE TOOL BUILDERS will demonstrate

THE NEW, HIGHER ORDER OF ECONOMY, SPEED AND EFFICIENCY YOU CAN OBTAIN FROM MODERN MACHINES EQUIPPED WITH CARBOLOY CEMENTED CARBIDE TOOLS.

FOR A COMPLETE LIST OF DEMONSTRATIONS visit CARBOLOY BOOTH E-206

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CEMENTED CARBIDE

HEALD
PRECISION
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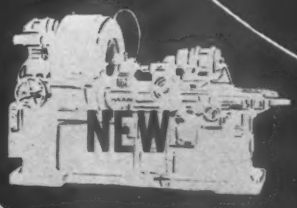
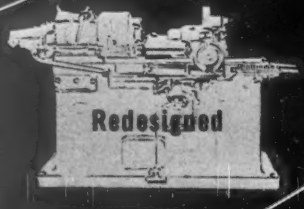
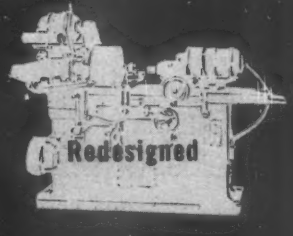
MACHINES







SEE THEM AT THE CLEVELAND SHOW

BOOTH 206

ALSO 8 OTHER *PROVEN PRODUCTS*

At Cleveland, we will exhibit 22 machines in actual operation on regular production work. Ten are brand new and have never been exhibited before. They include a Gap Internal for work needing large swing • An Internal for handling work larger than our standard No. 72's • Centerless Internal Grinding Machines • A Precision Boring Machine specially designed for facing and grooving • A Bore-Matic for precision boring automobile cylinders and other large castings • A new small double-end Bore-Matic • Also a new single-end Bore-Matic for manufacturers with small production. Four of the 22 have been completely redesigned and much improved. The balance are proven products operating satisfactorily in hundreds of shops. See this outstanding exhibit, with many new products of the most modern design!

THE HEALD MACHINE COMPANY, Worcester, Massachusetts., U.S.A.

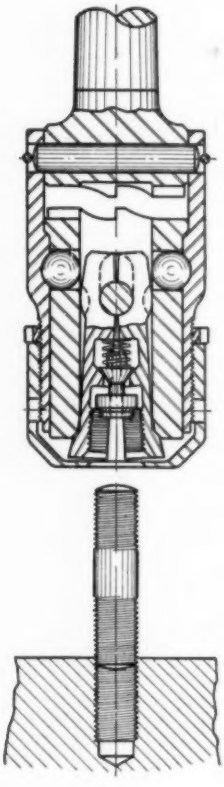
A New Self Opening Stud Setter

By FORD R. LAMB
MEMBER A.S.T.E.

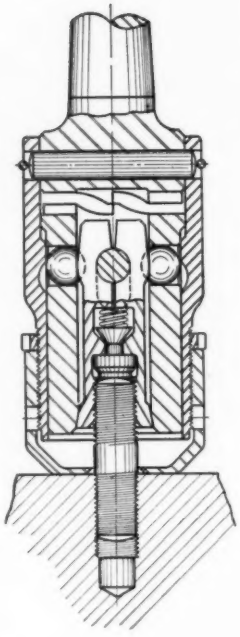
New principles are used in the design of a new Stud Setter recently brought out by Modern Tool Works Division of Consolidated Machine Tool Corporation, Rochester, New York. This tool has its operation interlocked to make it go through a certain cycle of movement and prevents injury or accident on the stud.

The jaws have a rectangular cross section and the sides of the jaws are ground to a close fit tolerance for sliding action in and out of the driving shell. This construction prevents any shift of the jaws from torque strains and causes positive register and alignment of the threaded section or bore of the jaws.

The jaws, with complementary threaded bores, open with a hinge type movement over a center pin and are provided with bearing surfaces so that when moved up into the driving shell the proper amount forms a true threaded bore. A recess at the top of the jaws forms a seat for interlocking balls which lock the jaws in this position. The action of locking the jaws in the driving shell also releases the driving shell from its locked position with the outer shell and permits engagement of the drive.



The sectional views will show how the Tool goes through the cycle of operation in driving a stud. First the stud to be driven must be inserted into the threaded bore and the jaws moved up to the proper closed position in the driving shell. At this point the interlocking balls lock the jaws to the driving shell and release the driving shell for movement upward to engage the drive clutches.



When the stud is driven down until the adjusted stop collar contacts the work the downward movement of the tool is stopped but the continual movement of the stud into the work pulls the driving clutch and jaw assembly down, thereby disengaging the clutches and cutting off the drive.

Upward movement of the tool by the operator moves the driving clutch and jaw assembly slightly further down in the tool until the interlocking balls register with the grove in the outer shell thus locking the outer shell and releasing the jaws to open. The entire cycle of operation is as fast as an operator can move.

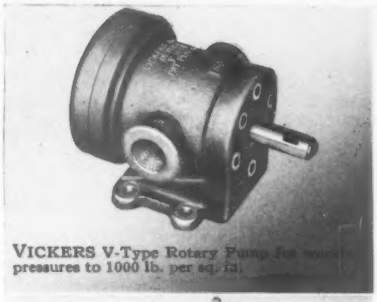
This design permits using this stud driver on any type of stud job, something which has never been accomplished before.

Studs can be driven to even height or to a shoulder by any power means.

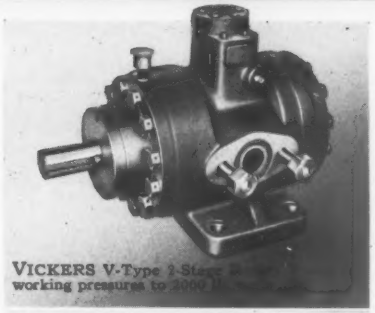
If a stud is broken off in the tool a slight jar on the tool will cause the piece of broken stud to drop out.

This stud driver is the fastest tool of its kind for it requires only sufficient revolutions to turn the stud into the work. No time is used to run on the stud, run off the stud or reverse.

This new design of stud setter can be furnished with any standard or special shank for application on any type of power unit on any type of stud driving operation.



VICKERS V-Type Rotary Pump for ... pressures to 1000 lb. per sq. in.



VICKERS V-Type ... working pressures to 2000 ...

VICKERS ... Pump and Valve Unit delivers ... low pressure and small volume ...

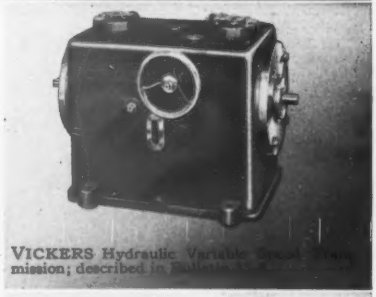
VICKERS Electric ... is available in ...

VICKERS Feed Control Valve ... tively controlled rate of flow ... changes in operating pressure ... ance.

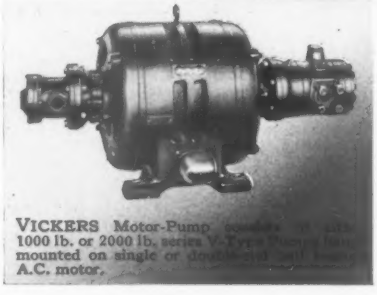
... Balanced Gear Pump and ... nates thrust ...

A COMPLETE line of manually and ... cally operated Vickers pilot valves ...

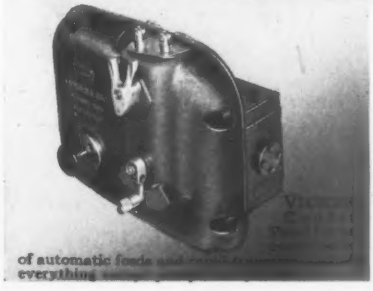
VICKERS Hydraulic Relief Valve ... for pressures to 3000 lb. per ...



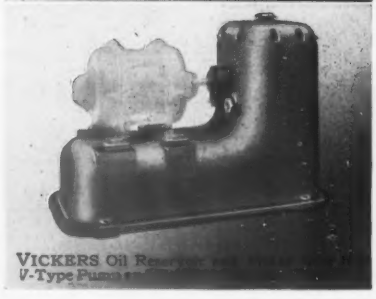
VICKERS Hydraulic Variable ... mission; described in ...



VICKERS Motor-Pump ... 1000 lb. or 2000 lb. series V-Type ... mounted on single or double ... A.C. motor.



... of automatic feeds and ... everything ...



VICKERS Oil ... V-Type Pumps ...

You are cordially invited to see the line of Vickers Hydraulic Equipment in Booth No. E-412 at the Machine Tool Show. Illustrated here are only a few of the standard Vickers units that can be arranged to provide practically any required feeds and sequence of motions. You should also inspect the applications of Vickers Equipment on machine tools exhibited at the Show by many of the leading builders.

VICKERS
INCORPORATED
1400 OAKMAN BLVD.
DETROIT MICHIGAN

Exhibitor	Booth No.	Exhibit
The Bristol Co. Waterbury, Conn.	A-303	Socket set and cap screws, pipe plugs, indicating and controlling instruments.
Buckeye Portable Tool Co. Dayton, Ohio	A-407	Hercules portable pneumatic and light high frequency electric tools.
The Bunting Brass & Bronze Co. Toledo, Ohio	A-208	Bronze bearings, bushings, washers, castings, bars.
Carborundum Co. Niagara Falls, N. Y.	E-408	Grinding wheels and other abrasive products, portable sanding mchs.
Carpenter Steel Co. Reading, Pa.	A-501	Tool steel, stainless steel and alloy steel.
Century Electric Co. St. Louis, Mo.	A-405	Electric motors and fans.
The Chicago Belting Co. Chicago, Ill.	A502	Belting, running exhibit.
The Cleveland Twist Drill Co. Cleveland, Ohio	E-306	Drills, reamers.
The Cleveland Worm & Gear Co. Cleveland, Ohio	A-105	Worm gears, worm speed reducers, central pressure lubricating system.
Clipper Belt Lacer Co. Grand Rapids, Mich.	A-415	Belt lacer.
Colt's Patent Fire Arms Mfg. Co. Hartford, Conn.	E-210	Metal parts—washing and drying machine.
The Cushman Chuck Co. Hartford, Conn.	E-410	Cushmatic chucks and power units, hand operated chucks.
Cutler-Hammer, Inc. Milwaukee, Wisc.	E-201	Electric control apparatus used on "starting, stopping and regulating" machine tools.
Dayton Rogers Mfg. Co. Minneapolis, Minn.	A-207	Holocator for angle peats, metal stampings.
The Dayton Rubber Mfg. Co. Dayton, Ohio	A-504	Cog belt drives, V-belt drives.
DeWalt Products Corp. Lancaster, Pa.	A-403	Pattern shop machinery.
Elwell-Parker Elec. Co. Cleveland, Ohio	E-402	Power operated industrial crane trucks.
The Euclid Elec. & Mfg. Co. Euclid, Ohio	A-202	Electric motor control apparatus.
Fairbanks, Morse & Co. Chicago, Ill.	A-215	Motors, pumps, scales, drives.
The Fafnir Bearing Co. New Britain, Conn.	E-312	Ball bearings and ball bearing power transmission equipment.
Federal Products Corp. Providence, R. I.	E-502	Dial indicators, precision measuring instruments.
Firth-Sterling Steel Co. McKeesport, Pa.	A-206	Sintered carbides, tools and dies.
Ford Motor Co. Dearborn, Mich.	A-201	Johansson gage blocks, accessories.
The Fostoria Pressed Steel Corp. Fostoria, Ohio	A-411	Coolant filter machine lamp sealing compound.
Fulton Foundry & Mch. Co. Inc. Cleveland, Ohio	A-212	High test iron castings.
General Electric Co. Schenectady, N. Y.	E-206	Motors, control apparatus, switch gears, "Carboloy" cemented carbide tools.
Gits Bros. Mfg. Co. Chicago, Ill.	A-406	Oil seals, oil cups, lubr. devices.
Gogan Machine Corp. Cleveland, Ohio	A-211	Hardness testing machines.
Greenerd Arbor Press Co. Nashua, N. H.	E-506	Greenerd Arbor Presses.
Harnischfeger Corp. Milwaukee, Wisc.	E-504	Arc welders, electric hoists, stat. elec. motors.
The Henry & Wright Mfg. Co. Hartford, Conn.	E-308	Dieing mch., steel presses automatic reels.
Hobart Bros. Troy, Ohio	E-103	Electric arc welding machinery.
E. F. Houghton & Co. Philadelphia, Pa.	E-204	Cutting oils, belting, general lubricants.
Hyatt Roller Bearing Co. Harrison, N. J.	A-409	Anti-friction bearings for machine tool applications.
Hydraulic Press Mfg. Co. Mount Gilead, Ohio	1014	Hydro-power fastraverse presses, pumps and controls.
International Nickel Co. New York, N. Y.	A-505	Metals.
The Chas. L. Jarvis Co. Gildersleeve, Conn.	E-203	Flexible shafting, screw driving and nut setting machines, accessories.
F. A. Kershaw Kent, Ohio	A-314	Boring tools.
The Lincoln Electric Co. Cleveland, Ohio	E-310	Arc welders and electric motors.
Link-Belt Co. Chicago, Ill.	E-302	Silent and roller chain, variable speed devices and speed reducers.
Lufkin Rule Co. Saginaw, Mich.	A-302	Welding and cutting supplies.
Macklin Co. Jackson, Mich.	A-416	Grinding wheels.
Madison-Kipp Corp. Madison, Wisc.	E-208	Die casting machines.
Marlin-Rockwell Corp. Jamestown, N. Y.	E-200	Bearings, ball gauging procedure.
Master Tool Co. Inc. Division Eastern Cutter Sal. Corp. Cleveland, Ohio	A-306	Milling cutters, drills, reamers, files, pneumatic tools, riveters, paving breakers.
Micromatic Hone Corp. Detroit, Mich.	E-205	Portable automatic engine cylinder re-conditioning equipment.
Morse Chain Co. Ithaca, N. Y.	A-210	Silent and roller chain drives, flexible couplings, clutches, speed reducers.
Motor Improvements, Inc. Newark, N. J.	A-402	Oil filters.
The New Departure Mfg. Co. Bristol, Conn.	E-406	Speed power units, ball bearings.
Norma-Hoffman Bearings Corp. Stamford, Conn.	A-401	Precision ball, roller and thrust bearings.
Oakite Products, Inc. New York, N. Y.	A-103	Industrial cleaning materials.
O. K. Tool Co. Inc. Shelton, Conn.	A-313	Milling cutters, boring heads, planer and lathe cutting tools.
Parker Appliance Co. Cleveland, Ohio	A-308	Component accessories.
The C. F. Pease Co. Chicago, Ill.	A-104	Blue print machinery.
The Pellow Machine Co. Detroit, Mich.	E-405	Air driven sheet metal working machine.
Power Transmission Council New York, N. Y.	E-214	Power transmission units, group drive.
Thomas Prosser & Son New York, N. Y.	E-105	Small tools—Widia metal tipped.
Producto Machine Co. Bridgeport, Conn.	A-301	Die sets and accessories.
Reeves Pulley Co. Columbia, Ind.	E-209	Variable power transmission.
Robbins & Myers, Inc. Springfield, Ohio	A-214	Motors, generators, fans.
The Rockwood Mfg. Co. Indianapolis, Ind.	E-414	Pulleys and belt drives.
Rotor Air Tool Co. Cleveland, Ohio	E-314	Portable air grinders, buffers, sanders and drills.
S K F Industries, Inc. Philadelphia, Pa.	A-102	Component accessories.
Skinner Chuck Co. New Britain, Conn.	E-400	Lathe chucks.
Square D Company Detroit, Mich.	A-213	Electrical equipment, switches and panels.
Standard Oil Co. Chicago, Ill.	S-4	Cutting oils.
Standard Pressed Steel Co. Jenkintown, Pa.	A-211	Unbrako screws, stools, chairs, work benches.
The Standard Tool Co. Cleveland, Ohio	E-303	Reamers, milling cutters, taps, chucks and special tools.
L. S. Starrett Co. Athol, Mass.	A-203	Machinists tools such as micrometers, vernieres, squares, gages, abrasive grinding wheels.
Sterling Grinding Wheel Co. Tiffin, O.	A-205	Abrasive grinding wheels.
D. A. Stuart & Co. Chicago, Ill.	E-503	Special industrial lubricants.
Sun Oil Co. Philadelphia, Pa.	E-505	Cutting oils used exclusively on machine tools.
Sunnen Products Co. St. Louis, Mo.	A-413	Portable grinder.
Synthane Corp. Oaks, Pa.	A-404	Laminated Bakelite sheets, rods, tubes, gear blanks.
The Taft-Pierce Mfg. Co. Woonsocket, R. I.	A-307	Gages, small tools, magnetic chucks, precision reamers.
The Timken Roller Bearing Co. Canton, Ohio	E-500	Tapered roller bearings.
Toledo Scale Co. Toledo Ohio	E-309	Automatic scales, automatic printing scale eccessories.
Tuthill Pump Co. Chicago, Ill.	A-204	Oil pumps and cups.
Twin Disc Clutch Co. Racine, Wisc.	E-404	Machine tool clutches.
Tyson Roller Bearing Co. Massillon, Ohio	A-216	Bearings.
Union Mfg. Co. New Britain, Conn.	A-311	Electric chucks, chain hoists.

(*Continued on page 64*)

ILLUSTRATION shows a particularly satisfactory HYDRAULIC TWO SPINDLE PISTON SLITTING MACHINE—for slitting the vertical and horizontal slots in aluminum alloy pistons, both slots being cut simultaneously. Production with hand operated rotary index table 600 pistons per hour. • Advance design in construction allows adaptation for *various uses*. Complete information will be sent to you for the asking.

• • •

SNYDER TOOL & ENGINEERING CO.
DETROIT, MICHIGAN

SNYDER TOOLS

Milling Cutter Power Requirements

By O. W. WINTER,
MEMBER A.S.T.E.
Manager Cutter Division Whitman & Barnes, Inc.

Editor's Note:

The author supervised a research project on the question of the power required for milling. This project was under the joint auspices of the Cincinnati Milling Machine Co. and the Ohio State University.

The power required is a very important factor in rough milling cuts and is usually the factor limiting the amount of feed possible and the resulting production. It is absolutely essential when making production estimates that the power required be checked with that available.

The following paper is of considerable importance and merits the attention of tool engineers.

THERE is probably no phase of engineering, wherein more has been accomplished with proportionately so little exact knowledge of the subject, as in the field of machine shop practice, particularly metal cutting. Another way of stating conditions is that there is probably more guessing done in machine shop practice than in any other phase of engineering.

We do not necessarily criticize this condition, as we believe any theory must be tempered with practicability with due consideration of the cost in dollars and cents of applying the theory and consideration of the benefits derived. Too much theory is entirely possible.

Yet there has always been, and still is to a certain extent, a need for more exact knowledge of metal cutting. There have been some very commendable contributions on the subject, but we believe there is much more work to be done.

One of the least understood metal cutting operations is milling. There are reasons for this. In the study of metal cutting, certain important variable factors must be considered and controlled. In milling, as compared with turning or drilling for example, there are an unusually large number of factors to be considered.

VARIABLE FACTORS

It is generally agreed from past investigations of the subject of milling and is confirmed in many cases by this project, that the following variable factors affect the efficiency of a milling cutter or rather, the power required to drive a milling machine.

1. The Efficiency of the Machine and Driving Motor (if motor driven).
2. The Material being milled.
3. The Milling Cutter Design.
   a. Number of Teeth in Cutter.
   b. The shape of the Teeth, i.e., Rake, Spiral and Clearance angles.
   c. The Amount of chip clearance between the teeth.
4. The Nature of the Cut.
   a. Cutting on face or periphery of cutter or both.
   b. Direction of Cutter Rotation relative to Table Feed.
   c. Chatter.
5. The Metal Removal.
   a. Table Feed in Inches per minute.
   b. Width and Depth of cut.
6. The Shape of the Chips Removed.
   a. Feed per tooth.
   b. Depth of Cut.
   c. Direction of Cut.
7. The Cutting Lubricant.
8. Condition of Equipment.
   a. Condition of Cutter Edge.
   b. Condition of Machine.

This is an actual total of 14 variable factors with no effort toward undue ramification.

In order to properly cover only a practical portion of these factors it was necessary to make approximately 35,250 tests to cover the efficiency of 5 types of cutters milling Cast Iron, 4 types milling Nickel Chromium Steel, 4 types on Cast Duralumin.

FUTURE PROJECTS

To cover the field entirely, approximately 230,000 tests should be made on each material studied. This would involve 9 sizes and designs, each of 5 types of cutters, 45 in all, taking tests of 16 different sizes cuts per cutter at 10 different feeds and 4 speeds and 4 readings for every combination of the above. In addition to this, all tests should be duplicated with cutter rotation with the direction of table feeds as well as against or, both up and down cuttings.

Also on those materials possible similar tests should be made using various cutting materials other than high speed steel for which the above is intended. The practical value resulting from such a coverage of tests wherein not only total power required but pressures developed on the work are noted should warrant the time and expense involved. Observations on cutter life should also be made.

The conditions under which these observations were made, it will be seen later, duplicate as close as possible present day milling practice in regard to cutter design, cutting lubricant used, size of cuts, speeds and feeds encountered, etc.

PURPOSE OF THIS PROJECT

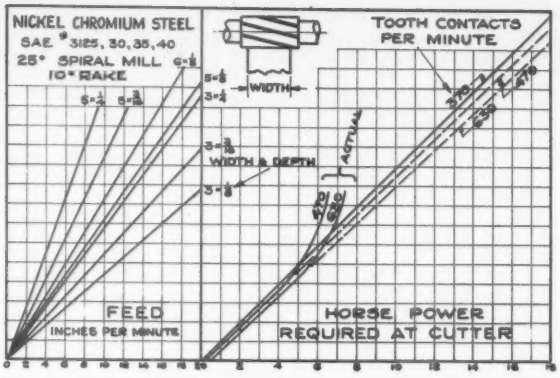
This particular project investigates certain variable factors from a basic theoretical standpoint, but its primary purpose is to make available to engineers and shopmen a convenient, quick, yet accurate and reliable means of determining the following:

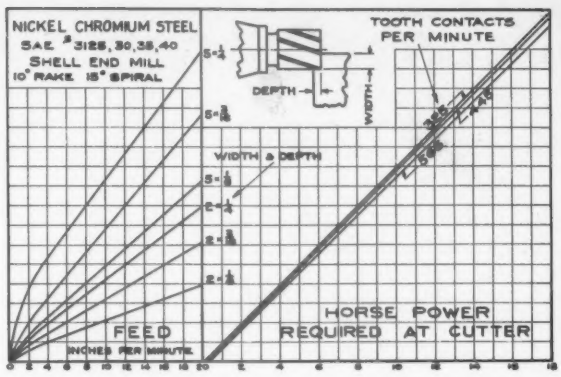
1. In production estimating
   a. The power required to use a particular rate of feed.
   b. The size of standard machine needed.
   c. The size of driving motor required.
   d. The feed rate allowable with a specific machine and hence the production obtainable.

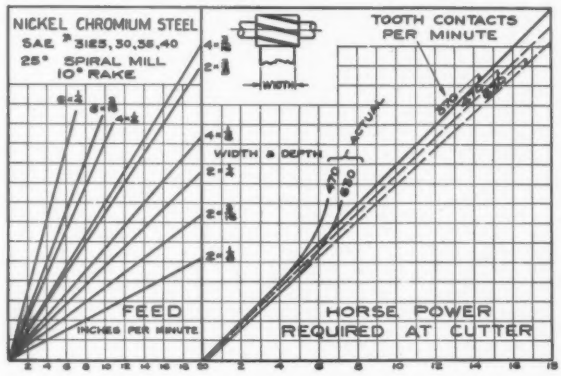
(Continued on page 52)

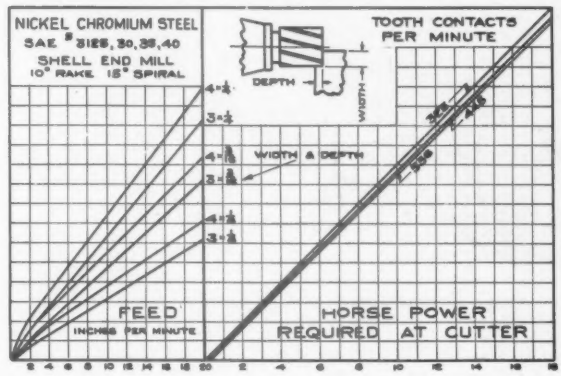
TEAR OUT THIS PAGE AND FILE FOR FUTURE REFERENCE.

MILLING CUTTER POWER REQUIREMENTS
NICKEL CHROMIUM STEEL

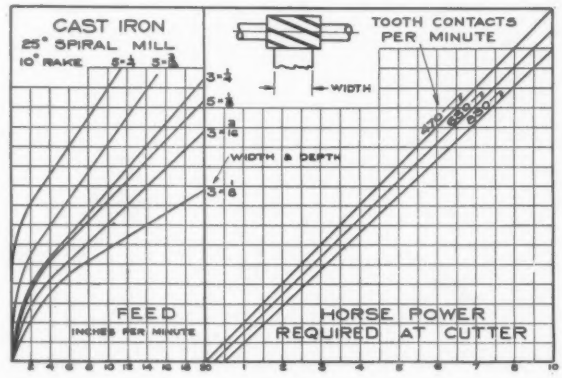


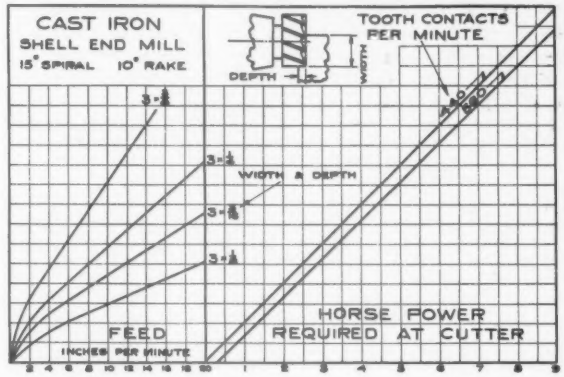


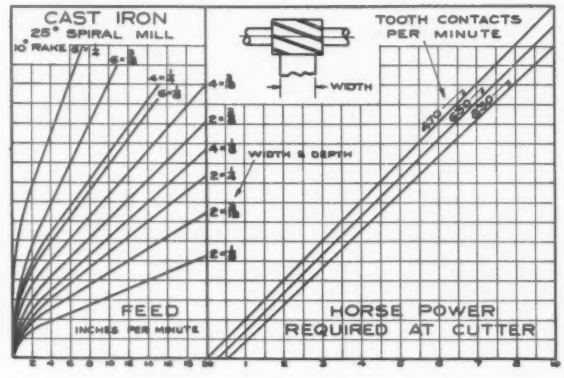


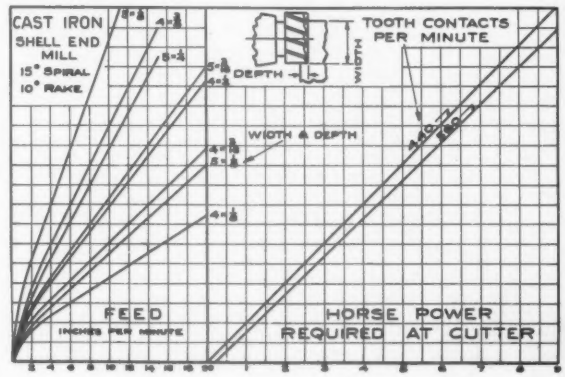


MILLING CUTTER POWER REQUIREMENTS
CAST IRON







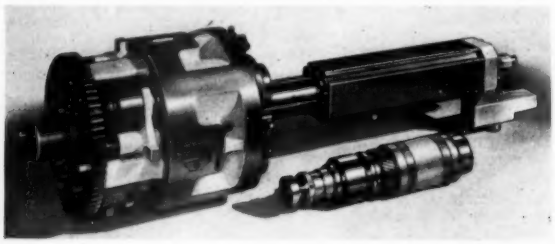


THIS MONTH'S COVER

NEW BRITAIN AUTOMATIC SCREW MACHINES

The new line of New Britain Automatic Screw Machines consists of Four and Six Spindle Machines in various sizes up to 2¼" capacity.

These machines are completely new from the base line up, with the fundamental aim in their design, being, to develop multiple spindle machines with initial accuracy, permanency of accuracy and long life.



Spindle Carrier Assembly with tool slide and stem.

The spindle carrier assembly, with the tool slide and its stem, is rightly called the heart of a multiple spindle machine. This unit is subject to continuous hard service and constantly exposed to wear, which, if not controlled, must of necessity destroy original accuracy and greatly shorten the life of the machine. In the new line of New Britains, previous or existing models were entirely ignored, and new exclusive features were developed and included, all designed to eliminate or minimize wear, thereby assuring the desired longevity.

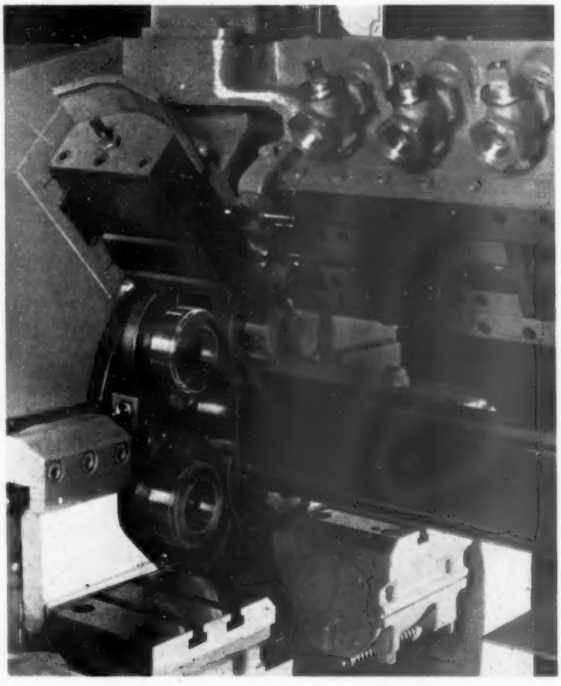
Some of the exclusive features included in the New Britain Spindle carrier assembly are briefly enumerated and described in the following: Preloaded ball bearing spindle mounting which eliminates all radial or axial deflection; an automatic spindle carrier lifting mechanism lifts the carrier off its seat during the indexing, and, thereby eliminates wear at this extremely vital point; an automatic spindle carrier clamping mechanism firmly clamps and locks the spindle carrier after the index movement; Alloy steel locking bolt inserts are hardened and ground, and accurately spaced for precision indexing; a rectangular tool slide, hardened and ground internally and externally, reciprocates on a hardened and ground tool slide stem, which forms practically an integral unit with the spindle carrier, and, assures permanent alignment of the tool slide with axes of the spindle. These features, combined with precision manufacturing methods, insure a carrier unit initially and permanently accurate.

Other mechanisms and parts of the machine were designed with the same aim, namely, to secure a properly co-ordinated tool which would stay accurate.

Heavy construction is employed throughout with the frame, base, head stock and power box firmly bolted and doweled together, forming practically one massive unit. Cross slides are mounted on large diameter, hardened and ground circular steel studs, entirely encircling their bearings, and eliminating all possibility of chips or grit working into the bearing surfaces. This construction affords exceptionally large bearing areas, eliminates all vibration, and thereby limits wear and permits of maximum feeds.

The chuck operating device, is of a new design, consisting of a series of barrel shaped rollers held in inner and outer sleeves, and which is anti-friction in effect and unaffected by centrifugal force.

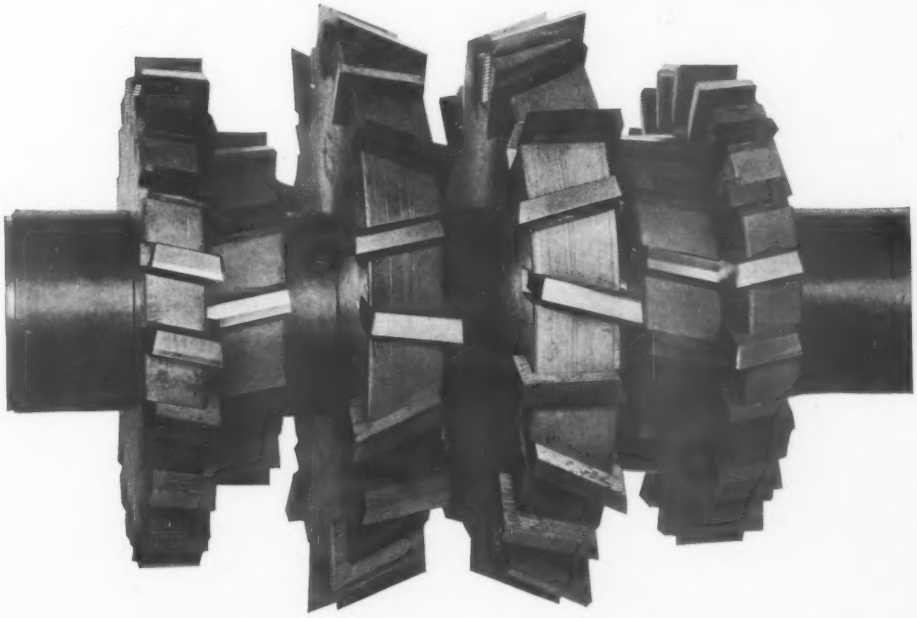
Alloy steel gears accurately machined after heat treatment, hardened and ground alloy steel shafts, mounted on anti-friction bearings are employed throughout. Lubrication is of the automatic circulating type, assuring ample lubrication to all parts of the machine. All these features tend towards the main objectives, of accuracy, continuous accuracy and longevity.



Close-up of spindles showing cross slides, tool slides and auxiliary slides.

G&G **Inserted Milling Cutters made of the serrated blade and wedge construction positively hold the blades against slipping. This has been proven by the application of this construction to the heaviest class of milling over a period of e i g h t y e a r s.**

As a further advantage of this construction the blades can be adjusted radially in increments of the pitch of the serrations (1/16″) or axially to any position, the adjustments being entirely independent of each other. The supposedly correct ratio of adjustment of peripheral and side cutting edges of face mills for your job is not predetermined by the manufacturer nor limited by mechanical construction.



The above Gang consisting of Half Side Mills, Plain Mills, and Staggered Tooth Angular Cutters illustrates the universal adaptability of this construction.

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WE WILL BE ON HAND TO ANSWER YOUR
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Milling Cutter Power Requirements

(Continued from page 46.)

2. In designing.
   a. Variable feed cams for either hydraulic or cam feed milling machines.
   b. Size of motor required or drive parts for a special milling machines.
3. In the shop.
   a. Determining if millers are being used to capacity.
   b. Determining if they are being overloaded.
   c. The maximum allowable feed rate for any job in question.

SCOPE OF THIS PROJECT

The project covers the following materials and cutters:

I. Cast Iron
   1. Shell End Mills
   2. Face Mills
   3. Half Side Mills
   4. Spiral Slab Mill
   5. Slotting Cutters

II. Nickel-Chromium Steel (SAE No. 3125, 3130, 3135 and 3140)
   1. Shell End Mills
   2. Half Side Mills
   3. Spiral Slab Mills
   4. Slotting Cutters

III. Cast Duralumin
   1. Face Mills
   2. Half Side Mills
   3. Spiral Slab Mills
   4. Slotting Cutters

IV. Wrought Duralumin
   1. Face Mills
   2. Spiral Slab Mills
   3. Slotting Cutters

METHODS AND GENERAL RESULTS

In the following each previously listed variable factor is discussed and it is shown how this project recognized and accounted for the same.

I. The Efficiency of the Machine.

The ratio of the amount of power put into a milling machine and the amount delivered to the cutter is a factor that varies with different types and makes of machines. In addition to this the efficiency of the driving motor is a variable factor over different power demands.

One of the first steps in this project was to determine the net efficiency of the driving motor, and the milling machine used, over all speeds and at increments of one horsepower. After half of the cutting tests were run, these efficiency tests were repeated to serve as a check and were confirmed.

The equipment used, consisted of a prony brake mounted on the spindle nose of the milling machine. Through this we were able to determine the horsepower output of the milling cutter versus the watt input to the machine driving motor, measured by a sensitive wattmeter. This was done for all spindle speeds used and from zero to the maximum horsepower available.

It is a known fact among milling machine builders that the power required to feed the table is slight compared with that needed to rotate the cutter. For this reason the efficiency tests of the spindle drive and motor were deemed sufficient for all practical purposes.

In the charts that will follow in subsequent issues, the horsepower shown is that required *at the milling cutter*. To this figure should be added 10% to 20% additional depending on the design of the milling machine spindle drive under consideration when the power required to drive the machine is desired. Conversely the same amount should be deducted from the power available when the feed rate allowable is being computed.

II. The Material being Milled

This was not a study of the machinability of various materials. Yet some light is thrown on this phase of the subject. The materials investigated were:

1. Cast Iron—medium grade
   Shore Scleroscope reading 30 to 35.
   Tensile strength 15,000 to 20,000 lbs/sq. in.
2. Nickel-Chromium Steel SAE No. 3125, 3130, 3135, and 3140 **Annealed.**
   Brinnell Hardness 140 to 150.
   Tensile strength 90,000 to 100,000 lbs/sq. in.
3. Cast Duralumin.
4. Wrought Duralumin—Brinell hardness 90 to 105.
   Tensile strength 55,000 to 63,000 lbs/sq. in.
   Yield Point 30,000 to 40,000 lbs/sq. in.
   Compressive Strength at least equal to Tensile strength.
   Modulus of Elasticity to 10,000,000 lbs/sq. in.

In order to avoid inconsistencies in the physical properties of the material used in the tests, four cuts were taken for each test, i.e. for each combination of feed, speed, size of cut, etc., each cut being taken on a different test block.

The respective machinability of these materials is shown below. With each type of cutter considered are listed the materials in order of ease of machining or power required, the first material listed requiring the least power, etc.

The approximate percentage of increased power requirements of each material over the first one listed is also shown. This is a rough figure however and actually varies considerably with various conditions of feed, width and depth of cut, feed per tooth, etc.

1. **Shell End Mills**—Cast Iron 100%—Nickel Chromium Steel 200%.
   (Other materials not tested).
2. **Face Mills—Cast Iron** 100%—Wrought Duralumin 120%.
   Cast Duralumin 155% (No tests made on steel).
3. **Half Side Mills**—Cast Iron 100%—Cast Duralumin 112% Nickel. Chromium Steel 174% (no tests on Wrought Duralumin).
4. **Spiral Slab Mills**—Cast Iron 100%—Nickel

(Continued on page 54.)

(*Continued from page 52.*)

Chromium Steel 190%.
Wrought Duralumin 93%—Cast Duralumin 133%.

NOTE:—A 25 degree spiral mill was used on the first two materials and a 45 degree mill on the latter two, hence the above figures are inaccurate to a certain extent. The individual comparison of the duralumin is:

Wrought Duralumin 100%
Cast Duralumin 151%

5. **Slotting Cutters**—Cast Duralumin 100%—Wrought Duralumin 105%.
Cast Iron 118%—Nickel Chromium Steel 219%.

III. The Milling Cutter Design.

The **Number of Teeth** in a cutter is part of the function of feed per tooth. This is obtained by dividing the feed in inches per minute by the production of the cutter rpm and number of teeth in it. This latter product may be expressed as the number of cutter tooth contacts per minute.

Previous investigations have proven conclusively that the feed per tooth and hence its contributing factors have a definite effect on the power required to mill. Generally speaking the larger chips require less power per volume of metal removed per minute than small chips.

This was found to hold true up to a practical limit where the *chip clearance between the teeth* was insufficient and the cutter became clogged with chips.

This factor is accounted for in the working charts that follow, inasmuch as before the horsepower required is obtained from the feed in inches per minute a correction must be made for the number of *tooth contacts per minute*, which as previously stated is the *product of the cutter rpm and number of teeth.*

The **Shape of the Cutter Teeth,** it has been proven, also have a decided effect on power requirements. This refers to the rake, spiral and clearance angles.

The rake or hook angle is the angle of the front face of the tooth relative to a line perpendicular to and through the axis of the cutter, it has been proven has the greatest effect, by far, of the three angles named. In our work we made no attempt to investigate the effect of various rake angles but used cutters of modern accepted design, known by some as coarse tooth cutters, in the design of which there is little difference in the rake angle specifications of the various cutter manufacturers. The usual rake angle on general purpose solid cutters is approximately 10 degrees. This covers all cutters used in this project excepting inserted tooth face mills.

The *spiral angle* of the teeth, it has been found, has only a slight effect on power requirements provided the angle is not so small as to cause a hammering action and chatter or so great as to cause a prohibitive end thrust on the milling machine spindle. The spiral angle on shell end mills, face mills, half side mills and alternate tooth slotting cutters varies little among the standard cutters manufactured. On spiral slab mills some cutter manufacturers advocate a 45 degree spiral, others 25 degrees. We tried both. A 25 degree spiral mill was used on Cast Iron and Nickel Chromium steel, a 45 degree spiral mill on the Duralumin. A number of tests were made with the 45 degree mill on Cast Iron and the steel with practically no variation in power consumption. showing on cuts where the 25 degree cutter cut smooth. On cuts where it chattered however the 45 degree cutter, in some cases, was smoother and required less power (see discussion on chatter).

The *clearance angle* whether it be on the periphery or face of the cutter, was found to have little or no effect on power requirements provided it was neither so great as to cause chatter nor so small as to cause the heel of each cutter tooth to drag. In either extreme the effect was to increase the power required.

IV. The Nature of the Cut

In milling Cast Iron we found that on narrow cuts there was slight difference in the efficiency of one type of cutter over another except that the alternate tooth slotting cutters were about 6% to 7% more efficient. As the widths of cut increased however, the spiral slab mill cuts showed a decidedly greater power requirement over the face mill cuts ranging from 10% to 70%.

Milling Nickel Chromium Steel, SAE No. 3125 to 3140, there was practically no difference in the relative efficiency of half side mills and alternate tooth slotting cutters. The spiral slab mill cuts however required from 40% to 70% more power and the shell end mill cuts approximately 5%.

Milling Cast Duralumin alternate tooth slotting cuts were found to be on the average 55% more efficient than half side mill cuts of comparable size. On the other hand the face mill cuts were on the average 110% more efficient than the spiral slab mill cuts.

Milling Wrought Duralumin, face mill cuts were more efficient than the spiral slab mill cuts. This ranged from 10% to 55%, the greatest difference occurring at the cuts of small depth. This latter was probably due to insufficient chip clearance in the face mill at the larger depth of cut.

All the foregoing comparisons are with equal widths and depths of cut, equal feed per tooth and feed in inches per minute. It can be seen that no general rule can be laid down as to whether milling on the face or periphery of a cutter is the more efficient. This will vary with different materials and types of cutters.

It will be noted that in all face mill type cuts covered by the working charts, there was a slight drag on the periphery of the cutter. This was found by experiment to have a negligible effect on the power required. Usually on face mill type cuts the cutting is done entirely on the face of the cutter. Not having to do this however in this project, naturally reduced the waste of test block material and time.

The *Direction of Cut* in all cuts taken in this work was with the cutter rotating against the feed or cutting up. Some recent studies have shown that in certain cases greater efficiency is obtained by rotating the cutter with the feed or a hook in cut,

(*Continued on page 56.*)

SPARTANS

THEY MADE IT

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Milling Cutter Power Requirements

(Continued from page 54.)

but under some circumstances less efficiency results. The present practice in milling is as the tests in this project were run. To investigate the efficiency of hook in cuts provides material for another project of this size or larger.

A *Chattering Cut* required more power than a smooth one. Outside of its deleterious effects, chatter causes wide fluctuations in the power requirements. These fluctuations usually being some way in harmony with the vibrations of the chatter itself. This is probably due to the cutter alternately digging in and receding from the work in addition to vibrating of high pitch, the latter being the more direct cause of the noise. The average of these power fluctuations was found in every case to be greater than the requirements for a non-chattering cut of the same size.

V. The Metal Removal

The power required to drive a milling cutter does not vary directly as the number of cubic inches of material removed per minute. The effect of these three factors is clearly represented on the charts that follow and the truth of this statement is obvious on investigation.

As far as we have investigated it seems that the product of the width by depth by feed, each having a proper fractional exponent, determined by test for the particular material and cutter under consideration may lead to something like a general power requirement formula. This requires a great deal of additional calculation and research.

VI. The Shape of the Chips Removed.

There is little known about the relation between milling cutter efficiency and the shape of the chips removed.

One of the factors effecting the chip shape is the feed per tooth. Previous investigations have shown, and this one substantiates, that in general efficiency is increased as the feed per tooth is increased. It is interesting to note that with everything constant and the above holding true, an increase in the feed, in inches per minute, can not cause a proportionate increase in the power required.

Another affecting factor is the depth of cut. When milling with the periphery of the cutter, increasing the depth of cut serves only to increase that part of the chip which logically requires less power to remove. Inasmuch as the greatest power is required at the beginning of the chip, doubling the depth of cut does not double the power required. On the face mill type cuts this is not true. In this case the width of cut varies the chip shape somewhat.

In the working charts that follow in succeeding installments of this series, both the depth of cut and feed per tooth, as represented by feed in inches per minute and tooth contacts per minute, are adequately recognized and accounted for.

Another factor affecting the chip shape is the direction of cut relative to the table feed. Again note that all cuts in this project were with the cutter rotating against the table feed.

VII. The Cutting Lubricant

The nature of the cutting lubricant used in milling probably affects the power requirements to, as yet, a relatively unknown extent. The coolants used in this project were in accord with current shop practice on the materials milled.

The Cast Iron was cut dry.

The Nickel Chromium steels were cut with 20 to 1 mixture of water and emulsifying oil (Sunoco, manufactured by the Sun Oil Co.)

The Duralumin was milled with straight kerosene. It was found that this gave the best finish and absence from chips sticking to the cutter edges.

VIII. Condition of Equipment

The condition of the cutting edges of the milling cutter teeth can cause a considerable fluctuation in power requirements. Fortunately however it was found that the power requirement variations due to cutter condition up to a certain point were moderate. Beyond this point there was a sharp increase in power absorbed accompanied by a detectable appearance of the cutter edges.

At this point the cutters used in the project were sharpened. In order to obtain a comparable average of readings, as stated before, four cuts were actually taken for each point shown on the charts. Each of these cuts were taken at different periods of the life of the cutter between grinds as much as possible. Also the razor edge resulting immediately after grinding the cutters was worn off before any tests were continued.

These precautions, conscientiously watched, resulted in an average figure for each point on the graphs that was unusually accurate and consistent.

The condition of the milling machine can affect the power required to drive it. It may be loose or weak causing power wasting chatter to occur or the design may be such that comparatively little power is actually delivered to the cutter.

The machine used in this project was a Cincinnati No. 2M Plain Miller equipped with a 7½ HP motor. The design and condition of this machine was such as to secure at the cutter high percentage of the power delivered by the motor and take the cuts covered by the charts without chatter.

Editor's Note: *A concluding installment of Mr. Winter's work on Milling Cutter Power Requirements will follow in an early issue. The use of his Charts will be described.*

Old and New Methods of Drilling

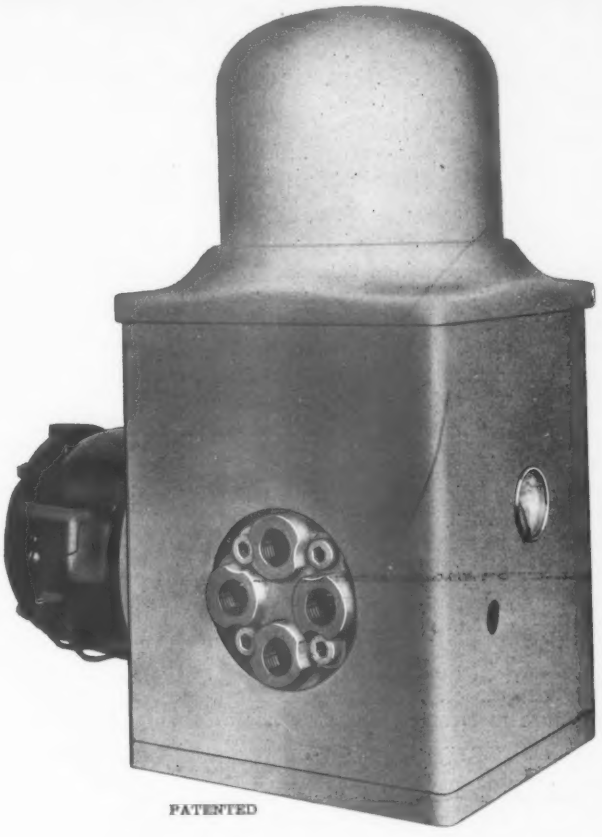
(Continued from page 23.)

develop what are known as "'Self-Contained Hydraulic Drilling Units." These units are complete machines within themselves. They carry their own oil reservoir, pumping and valving system, and the motor necessary for driving the pump, also the spindle cluster boxes. These units have been developed in sizes ranging from ¾ HP up to 20 HP, and can be mounted horizontally, vertically, or at

(Continued on page 60.)

New Britain HYDRAULIC UNIT

At the Show
Space 909



PATENTED

A compact dependable unit for operating chucks or work holding fixtures, on all types of machine tools and for one to four machines with a single or multiple control valve.

Pressures constant, but instantly adjustable to suit the job.

A constant speed pump builds up desired reserve pressure in an accumulator, affording the rapid action of air, and using only from 1/3 to 3/4 H.P. depending upon the number of machines.

Ideal for replacing existing air chucking, or, converting mechanical chucks to hydraulic operation.

Specify the New Britain No. 202 Hydraulic Unit on new equipment requiring power operated chucks.

Circulars on Request

The New Britain-Gridley Machine Company

New Britain, Conn., U. S. A.

THIRD MACHINE TOOL CONGRESS

September 11 to 20, 1935

AT

CLEVELAND, OHIO

Under the direction of

Machine Shop Practice Division, American Society of Mechanical Engineers

Production Activity, Society of Automotive Engineers

American Society of Tool Engineers

Cleveland Engineering Society

National Machine Tool Builders' Association

Purpose:

"To Provide a neutral forum, wherein engineers, users, distributors and producers may discuss freely all questions of mutual interest concerning the design and utilization of machine tools."

Wednesday Evening, September 11th

—I—

Under the direction of the Machine Shop Practice Division, American Society of Mechanical Engineers

Hotel Statler, Ball Room

8:00 p.m. Presiding, Philip E. Bliss, President, The Warner & Swasey Company, Cleveland, Ohio.

OPENING REMARKS by the Chairman of the Machine Tool Congress, C. R. Burt, President, Pratt & Whitney Company, Hartford, Conn.

SURFACE FINISHING BY CYLINDRICAL GRINDING

Howard W. Dunbar, Manager, Grinding Machine Division, Norton Company, Worcester, Mass.

INTERNAL SURFACE FINISHING

A. W. Schneider, Heald Machine Company, Worcester, Mass.

Thursday Evening, September 12th

—II—

Under the direction of the Machine Shop Practice Division, American Society of Mechanical Engineers

Hotel Statler, Ball Room

6:30 p.m. INFORMAL DINNER

Address: MACHINE SHOPS IN NAZI GERMANY

Kenneth R. Condit, Editor, "American Machinist."

Presiding: McRae Parker, Chairman, Cleveland Section, ASME; Director of Education, Cleveland Public Schools.

Dinner tickets on sale at Machine Tool Congress information desk in lobby of Hotel Statler..... **$1.50**

—III—

8:00 p.m. Presiding, James H. Herron, Consulting Engineer, Cleveland, Ohio.

CEMENTED CARBIDE CUTTING MATERIALS

Roger D. Prosser, of Thomas Prosser & Son, New York

MODERN METAL CUTTING

Motion pictures taken through a microscope, showing the action of a cutting tool in removing a chip.
Hans Ernst, Cincinnati Milling Machine Co., Cincinnati, Ohio.

Friday Evening, September 13th

—IV—

Under the direction of the American Society of Tool Engineers

Hotel Statler, Ball Room

6:30 p.m. INFORMAL DINNER—Music and Entertainment.

Presiding, R. M. Lippard, President, A.S.T.E; Detroit Manager, The Heald Machine Co.

Dinner tickets on sale at Machine Tool Congress information desk in lobby of Hotel Statler..... **$1.50**

8:00 p.m.—Standardization of Machine and Tool Data.

Speaker: W. H. Smila, Master Mechanic, Chrysler-Jefferson Plant, Detroit.
Covering the requirements of tool engineers, tool specifiers, and tool designers when specifying and tooling a machine for production.

Speaker: A. H. d'Arcambal, Pratt & Whitney Company, Hartford, Conn.
"Trend of the Development of Cutting Tools."

Monday Evening, September 16th

—V—

Under the direction of the Cleveland Engineering Society

Public Auditorium, Music Hall

8:00 p.m. Presiding, Jos. H. Gepfert, President, Cleveland Engineering Society; District Manager, Reeves Pulley Company.

The Place of the Foreman.

W. S. Knudsen, Vice President, General Motors Corp., Detroit, Michigan.

(Continued on page 62.)

Old and New Methods of Drilling

(Continued from page 58.)

any intermediate angle. They are provided with adjustable dogs so that the length of rapid traverse stroke to and from the work can be easily changed, and the depth of feeding can be adjusted. They are also provided with two separate independent rates of feed, both of which may be varied at the will of the operator. A fixed stop and a delay in the reverse at the end of the feeding stroke can also be provided, which permits accurate facing operations.

This type of unit is so adjustable, and has sufficient rigidity and accuracy in its construction that it permits the combining of many machining operations with the drilling. Such operations as—spotfacing, countersinking, reaming and counterboring, also boring, are successfully handled by this type of equipment. The fact that the unit is self-contained, and is built in a wide range of sizes and capacities, makes it easy to construct way machines. This same flexibility also makes it very easy to re-arrange machines when the series of operations are changed.

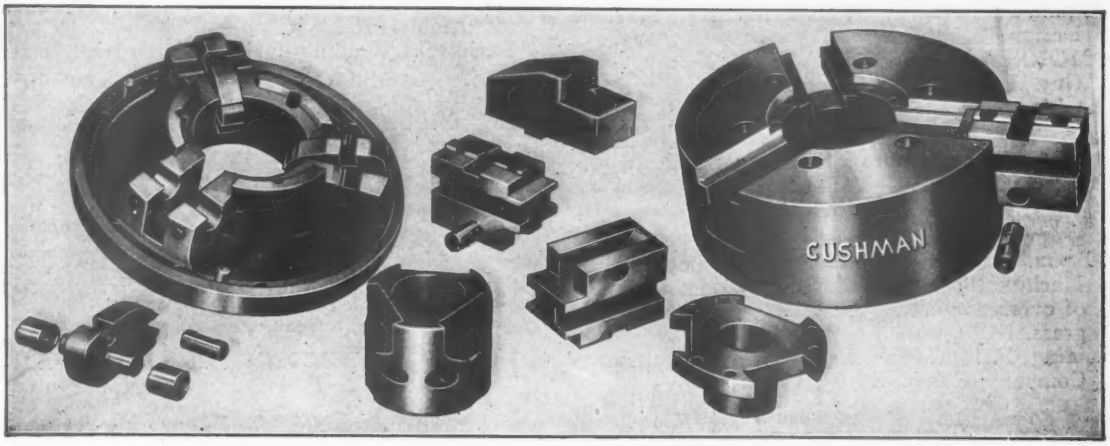
Paralleling the improvement in design of the hydraulic equipment has been an equally pronounced improvement in electrical equipment. Designers have taken advantage of this fact, and are combining hydraulic control with electrical control. This permits an easy arrangement of the control system for handling semi-automatic and full automatic cycles in what would otherwise be very complicated machines. As an example, machines are now being constructed in which the parts are automatically indexed from one position to another between the operating tools, by means of a trunnion type fixture, rotating tables, or straight line conveyor. The various functions of the separate parts of the machine, that is, the heads, fixture movements, together with the clamping of the parts, the starting and stopping of the machines automatically, and various safety devices, are now all interlocked to form a smooth operating machine.

It is also of interest to note that along with the drilling, facing and other operations which can and are being done with up-to-date so called drilling equipment, engineers are now combining tapping. The tapping spindles are carried in the drill spindle cluster boxes, but are driven by a separate reversing motor which is started, reversed, and stopped automatically at the proper time in the machining cycle. The addition of the tapping to the possibilities of this up-to-date equipment makes it possible to complete all work on the holes on a part in one machine, whereas, it formerly required a machine for drilling and countersinking, and another machine for the tapping operation.

It is hard to realize the wide range of operations and great variety in machine construction made possible by the use of these self-contained units, together with a modern hydraulic and electric control system. They lend themselves to the simplest type of one or two-way operations in which hand clamped fixtures are used. They are equally adapt-

(Continued on page 64.)

NEW THINGS AT THE MACHINE TOOL SHOW



Many new machines and tools have been developed since the last National Machine Tool Exposition in 1929. We will be glad to mail you any of these bulletins, and hope you will stop and see us at the Cleveland Show. The Cushman Chuck Co. booth (No. 410-E).

Mr. H. W. Hultgren, Assistant Secretary will be in charge, and he will be glad to show you the following Cushman products:

1. **"NO. 730 CUSHMATIC CHUCK"—**

   the electric power chuck for engine and turret lathes, etc. It will be shown operating under its electrically controlled No. 70 rotating Power Unit. (Bulletin 120-C.)

2. **"NO. 4-C-7 PULL-PUSH-POWER"—**

   the new power unit which converts rotary motion to straight line motion. This is an electrically operated Power Unit which will be demonstrated in action with a clevis connection on a frame designed for the purpose. (Bulletin 127.)

3. **"HAND OPERATED LATHE CHUCKS"—**

   Specimens of several Cushman light, medium, and heavy duty types. Note particularly the new standardized backs. (Bulletin 48.)

The Cushman Chuck Co.

HARTFORD, CONN.

THIRD MACHINE CONGRESS

(*Continued from page 58.*)

Tuesday Evening, September 17th

—VI—

Under the direction of the Cleveland Engineering Society

Cleveland Engineering Society Rooms
Hanna Building

8:00 p.m. Presiding, L. E. Jermy, Editor, "Machine Design."

TOMORROW'S MACHINE TOOLS
Guy Hubbard, Consulting Engineer, Cleveland, Ohio.

Tuesday Evening, September 17th

—VII—

Union Club
Euclid at 14th St.

7:00 p.m. FORMAL DINNER—By the National Machine Tool Builders' Association, in honor of overseas visitors to the Exposition and Congress.

Presiding, F. H. Chapin, President, National Acme Company, Cleveland, Ohio.

By Invitation

Wednesday Evening, September 18th

—VIII—

Under the direction of the Production Activity Society of Automotive Engineers
Hotel Statler, Ball Room

8:00 p.m. Presiding, Joseph Geschelin, Detroit Technical Editor "Automotive Industries."

Methods of Finishing Transmission Gears
S. O. White, Chief Engineer.
Marley Hedgeland, Development Engineer, Warner Gear Co., Muncie, Indiana.

Application of Induction Heating in Automotive Production
E. L. Bailey, Electrical Engineer, Chrysler Corporation, Dodge Division, Detroit, Michigan.

Rustproofing and Paint Adherence Technique
E. P. Spruance, American Chemical Paint Co., Ambler, Pa.

Resistance Welding in the Automotive Industry
J. A. Weiger, P. R. Mallory & Co., Indianapolis, Indiana.

A Quick Trip to the Machine Tool Exhibits
John R. Cox, Director of Manufacturing, Thompson Products Co., Cleveland, Ohio.

Thursday Evening, September 19th

—IX—

Under the direction of the Cleveland Section, Society of Automotive Engineers.
Hotel Statler, Ball Room.

7:00 p.m. PRODUCTION DINNER (informal)

Toastmaster, V. P. Rumely, Hudson Motor Car Company, Detroit, Michigan.

Dinner tickets on sale at the Machine Tool Congress information desk in lobby of Hotel Statler..... **$1.50**

8:15 p.m. Presiding, A. T. Colwell, Director of Engineering, Thompson Products Company, Cleveland, Ohio.

The Relation Between Manufacturing and Engineering
D. G. Roos, Studebaker Corporation of America.

THIRD MACHINE TOOL CONGRESS

(Continued from page 62.)

Friday Evening, September 20th

—X—

MEETING of the MACHINE TOOL CONGRESS

Hotel Statler, Lattice Room

8:00 p.m. Presiding, C. R. Burt, President.

Reports of Officers.

Report of Nominating Committee and Election of Directors.

Adjournment.

OLD AND NEW METHODS OF DRILLING

(Continued from page 60.)

able to complex progressive operations as shown in the construction of large rotary station machines for the drilling of cylinder blocks and cylinder operation.

The units are also being used for core-drilling, rough and finish boring and chamfering of the main and camshaft bearings in cylinder blocks, doing all this work automatically to a high degree of accuracy and at a high production rate. In this type of machine the units are arranged with an automatic fixture to form a conveyor type station machine. There is no similarity between the rotary and conveyor type machines in appearance, operation, and the work being done, and yet both machines are built up using the same type of self-contained unit and control mechanism.

(Continued from page 44.)

Exhibitor	Booth No.	Exhibit
Vanadium-Alloys Steel Co. Pittsburgh, Pa.	E-102	Tool steels, carbide tipped tools, cold drawn shapes.
Vickers, Inc. Detroit, Mich.	E-412	Hydraulic pumps, relief valves, control panels.
The V & O Press Co. Hudson, N. Y.	E-315	Presses, standard.
Wellman Bronze & Aluminum Co. Cleveland, Ohio	A-316	Bronze and aluminum castings.
Wesson Company Detroit, Mich.	A-209	Small tools.
Westinghouse Elec. & Mfg. Co. East Pittsburgh, Pa.	E-304	Motors—control and welding.
The Whitney Mfg. Co. Hartford, Conn.	A-315	Sprockets and chains.
Wiedemann Machine Co. Philadelphia, Pa.	E-313	Punches.
J. H. Williams & Co. New York, N. Y.	A-410	Drop forgings and forged tools.
Wilson Mechanical Instrument Co. Bronx, N. Y.	E-104	Mechanical instruments.
Yale & Towne Mfg. Co. Philadelphia, Pa.	E-100	Hoists, trolleys, trucks, tractors and trailors.
PUBLICATIONS		
American Machinist New Yrok, N. Y.	A-7	
Associated Machine Tool Dealers New York, N. Y.	"L"	
Chilton Co. ("Auto. Industries") Philadelphia, Pa.	A-2	
Industry & Welding Cleveland, Ohio	S-2	
Iron Age Publishing Co. New York, N. Y.	A-1	
Machinery New York, N. Y.	A-5	
Mill & Factory New York, N. Y.	A-4	
Modern Machine Shop Cincinnati, Ohio	A-8	
Railway Mechanical Engineer New York, N. Y.	S-1	
Steel Cleveland, Ohio	A-3	
The Tool Engineer Detroit, Mich.	A-6	

CUTTING TOOL TESTS

(*Continued from page 24.*)

cutting equipment was shown in the article, "Engineering Design Principles Simply Applied to Tool Engineering," published in the October, 1934 issue of this Journal. The principal factor considered in this article was the pressure developed on the tool and its effects on the various parts of a machine.

Another important factor as referred to above is the tool shape that will develop the least pressure and heat, and give the maximum tool life when cutting materials. The development of new cutting materials, alloy steels, and the many non-metallic substances has made further investigations in cutting highly desirable if not absolutely necessary.

Since the temperature created in cutting has a very marked effect on tool life, finish, etc., considerable attention has been given to the development of coolants and lubricants. Further experiments are now in progress to determine the relative efficiencies of these cutting compounds.

The principal items which require careful and accurate measurement in most cutting experiments are the component pressures; radial, feeding and tangential; temperature and tool life when turning; thrust and torque when drilling; normal and tangential force and energy consumption when milling.

The design of a reliable pressure measuring device is not simple. Various methods have been tried; each experimentor generally has certain ideas of his own which he thinks are best. In general, the working principle of most cutting tool dynamometers has fallen into one of the following groups:

1. Measurement of pressure through a fluid; i.e., by hydraulic means.
2. By the deflection of some member of the apparatus, beam deflection principle.
3. By the Piezo-electric method.

Of the three methods the hydraulic method seems to have proven to be most universally successful. The beam deflection method seems to be practical only where relatively low pressures are involved. The Piezo-electric method is more complex and requires a certain amount of rather delicate apparatus, however, very small increments of pressure can be measured.

The Germans have developed several quite successfull hydraulic type dynamometers for both lathes and drilling machines.

The Japanese have developed what seems to be a rather successful type of Piezo-electric dynamometer for the lathe, drill and milling machine.

The Tool Engineer may not be directly concerned in this experimental work, but the results obtained should be of considerable interest to him.

WHO IS A TOOL ENGINEER?

(*Continued from page 18*)

there yet remains much to be accomplished before the dreams of its members and directors are realized.

If you are engaged in tool engineering, your cooperation is needed,—and you need the cooperation of the American Society of Tool Engineers.

ROSS VALVES

"the bridle for air horsepower"

★ Save Air Costs

Ross Operating Valves truly "put a bridle on air horsepower." ★Accurate and positive control is assured over a long period of use.

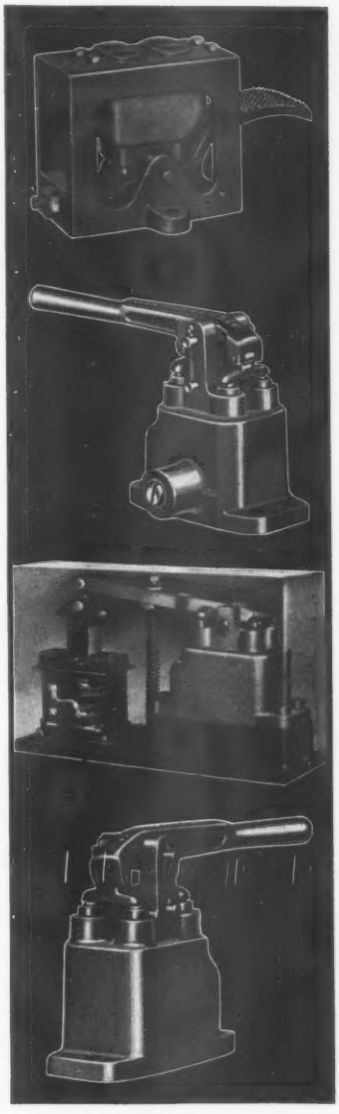
★Flexible seats—quickly renewable—eliminate all lapping or grinding and reduce "shut down" time to a minimum.

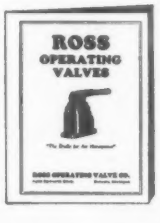
★Designed upon poppet principle with air pressure against seats to insure positive seal. ★Can be mounted on brackets to which piping is permanently attached.

★Ross Operating Valves are manufactured in sizes ranging from ⅜" to 1¼" for the control of single or double acting cylinders.

★Standard designs for hand—foot—mechanical —or electrical control.

★Investigate their possibilities for your use today.





Complete catalog, giving types, description and specifications, sent on request.

ROSS OPERATING VALVE CO.

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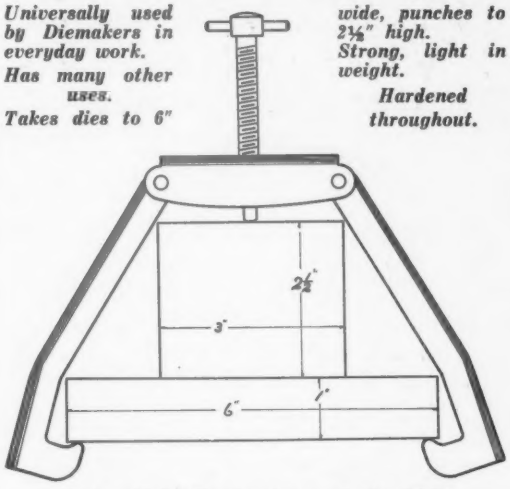
DETROIT, - - - - - MICH.

PUNCH CLAMP

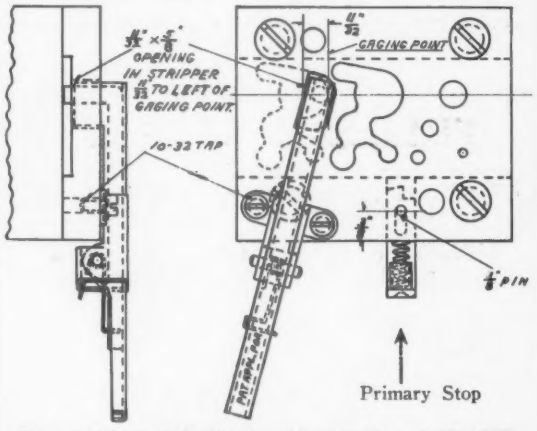
Universally used by Diemakers in everyday work. Has many other uses. Takes dies to 6"

wide, punches to 2½" high. Strong, light in weight. Hardened throughout.



Price $1.50 Each—lots of six $7.50

Krasberg Automatic Stop



The most economical automatic stop for all BLANKING and PROGRESSIVE dies.

SAVES 75% of regular automatic stop cost.

Strong, Simple. Can be fitted in 25 minutes.

2 SIZES: 2⅜" and 3⅜" from pivot to stopfinger.

AUTOMATIC STOP $1.00 EACH

PRIMARY STOP $0.30 EACH

15% discount in dozen lots.

R. KRASBERG & SONS MFG. CO.

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Chicago, Ill.

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